HUC 10290107 – Pomme de Terre
Water body IDs: 3822 and 1444
Pollutant(s): Organic sediment and unknown

Revised Total Maximum Daily Load for Piper Creek and Town Branch Polk County, MO

Impairments: Organic Sediment and Unknown

Submitted: November 10, 2020
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Prepared by: Water Protection Program, Watershed Protection Section

WATER BODY SUMMARY
Total Maximum Daily Load for Piper Creek and Town Branch
Pollutants: Organic sediment and Unknown

Name: Piper Creek and Town Branch

Location: Polk County near Bolivar

8-digit Hydrologic Unit Code (HUC):[1]
HUC 10290107 – Pomme de Terre

12-digit HUC Subwatersheds:
HUC 102901070303 – Piper Creek

Water Body Identification Number (WBID) and Hydrologic Class:[2]
Piper Creek: WBID 1444 – Class P
Town Branch: WBID 3822 – Class P

Designated Uses:[3]
Irrigation
Livestock and wildlife protection
Human health protection
Warm water habitat (aquatic life)
Whole body contact recreation category B
Secondary contact recreation

Pollutants and Sources Identified on the 2008 303(d) List:
Organic sediment – Bolivar Wastewater Treatment Facility
Unknown – Unknown

Length and Location of Impaired Segment:[4]
7.8 miles from the confluence of Piper Creek with Pomme de Terre River to Highway 83/Springfield Avenue in Bolivar, Section 12, Township 33N, Range 23W

Length and Location of Water Bodies Included in the Impaired Segment:
Piper Creek: 5.3 miles from Mouth to Section 31, Township 34N, Range 22W
Town Branch: 2.5 miles from Mouth to Section 12, Township 33N, Range 23W

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[1] Watersheds are delineated by the U.S. Geological Survey using a nationwide system based on surface hydrologic features. This system divides the country into 2,270 8-digit hydrologic units (USGS 2019). A hydrologic unit is a drainage area delineated to nest in a multilevel, hierarchical drainage system. A hydrologic unit code is the numerical identifier of a specific hydrologic unit consisting of a 2-digit sequence for each specific level within the delineation hierarchy (FGDC 2003).
[2] For hydrologic classes see 10 CSR 20-7.031(1)(F). Class P streams maintain permanent flow even in drought periods.
[3] For designated uses see 10 CSR 20-7.031(1)(C) and 10 CSR 20-7.031 Table H. Presumed uses are assigned per 10 CSR 20-7.031(2)(A) and (B) and are reflected in the Missouri Use Designation Dataset described at 10 CSR 20-7.031(2)(E).
[4] This distance varies slightly from what is presented on the 2008 303(d) list due to improved and higher resolution geographic information system data.

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1. Introduction

The Missouri Department of Natural Resources in accordance with Section 303(d) of the federal Clean Water Act is establishing this total maximum daily load (TMDL) to address the organic sediment and "unknown" impairment within and upstream of Town Branch and Piper Creek near Bolivar in Polk County. This Revised TMDL supersedes the TMDL established by the U.S. Environmental Protection Agency (EPA) on November 1, 2010, to meet the milestones of the 2001 Consent Decree, American Canoe Association, et al. v. EPA, No. 98-1195-CV-W in consolidation with No. 98-4282-CV-W, February 27, 2001. Piper Creek was first listed on the 1998 Missouri 303(d) List of impaired waters for non-filterable residue, and was listed on the 2002 Missouri 303(d) List for volatile suspended solids. Both listings cited the Bolivar Wastewater Treatment Facility as the source of the impairments. Piper Creek (Town Branch) was subsequently placed on the 2008 Missouri 303(d) List for organic sediment from the Bolivar Wastewater Treatment Facility, and for "unknown" pollutants from an "unknown" source.

Section 303(d) of the federal Clean Water Act and Title 40 of the Code of Federal Regulations (CFR) Part 130 require states to develop TMDLs for waters not meeting applicable water quality standards. Missouri's Water Quality Standards at Title 10 of the Code of State Regulations (CSR) Division 20 Chapter 7.031 consist of three major components: designated uses, water quality criteria to protect those uses, and an antidegradation policy. The purpose of a TMDL is to determine the loading capacity of a specific pollutant that a water body can assimilate without exceeding the applicable Water Quality Standards for that water body. The TMDL process quantitatively assesses impairment factors so that water quality-based controls can be established to reduce pollutant loading and to restore and protect the quality of Missouri's water resources. Based on the relationship between pollutant sources and in-stream water quality conditions, a TMDL is the sum of a wasteload allocation, a load allocation (40 CFR 130.2), and a margin of safety (federal Clean Water Act section 303(d)(1)(C)). The wasteload allocation is the fraction of the loading capacity apportioned to existing or future point sources. The load allocation is the fraction of the loading capacity apportioned to existing or future nonpoint sources, and natural background. The margin of safety is a portion of the TMDL that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality (40 CFR 130.7), any uncertainty associated with the model assumptions, and data inadequacies.

2. Rationale for Revision

Wasteload allocation studies were conducted in 2013 and 2018, and biological assessment studies were conducted in fall 2015 and spring 2016 in the vicinity of the Bolivar Wastewater Treatment Facility. Greater understanding of the characteristics of Town Branch, Piper Creek, and the surrounding watershed warrant a reevaluation of the impairment and the conditions for which water quality standards can be attained. Advances in geographical information systems (GIS) and additional information sources that have become available in the decade since the development of the original TMDL provide an opportunity to make such a reevaluation. Additionally, review of the 2010 QUAL2K model indicates the need for significant changes in some modeling assumptions and data inputs to create a better representation of actual stream hydrology and improved predictive ability.

The 2010 Piper Creek (Town Branch) TMDL established total nitrogen (TN) and total phosphorus (TP) wasteload and load allocations based on EPA Level III Ecoregion 39 (Ozark Highlands) criteria (USEPA 2000). However, the Ecoregion 39 nutrient criteria targets may not be

representative of more localized reference conditions. The targets are not tied to specific biological conditions or Missouri's minimum dissolved oxygen criterion. Additionally, these federally recommended nutrient criteria use a statistic-based distributional approach that has little or no linkage to biological "cause and effect" responses or ecologically significant thresholds, and merely represents an administrative water quality protection policy that guides EPA's clean water programs. For these reasons, these targets may not be appropriate metrics for use as wasteload allocations for point source discharge from wastewater treatment facilities. The Department has established pollutant targets in this revised TMDL that are proportionate to the existing land uses and geomorphic characteristics of Piper Creek, Town Branch, and the contributing watershed. The pollutant targets in the revised TMDL have been established such that organic sediment will be reduced to ensure conditions are consistent with Missouri's general narrative water quality criteria. The pollutant targets will also result in the reduction of benthic algae in the stream, which will benefit the natural biological communities. The targets will result in restoration of the protection of warm water habitat (aquatic life) designated use in Town Branch and Piper Creek, and will be protective of downstream uses.

The targets and information provided in this revised TMDL replace those found in the 2010 TMDL. The ultimate endpoint for this revised TMDL will be to meet Missouri Water Quality Standards through attainment of the general criteria and restoration of designated uses. Compliance with these criteria will be determined in accordance with Department assessment procedures for federal Clean Water Act sections 305(b) and 303(d) reporting. All pollutant reductions necessary to achieve the TMDL targets calculated in this revised TMDL shall be implemented until such a point that water quality standards are attained. If all point source and nonpoint source pollutant targets are achieved, but water quality standards are not attained, then additional monitoring will be scheduled and the TMDL may be further revised.

3. Water Body and Watershed Descriptions

Town Branch and Piper Creek are located in southwestern Missouri within the Pomme de Terre subbasin, which is catalogued by the U.S. Geological Survey (USGS) as the 8-digit HUC 10290107. Town Branch and Piper Creek are located in the Piper Creek 12-digit HUC (102901070303) subwatershed, which drains approximately 37 square miles. Town Branch originates near the Piper Creek subwatershed divide in Bolivar and flows northeast for 4.4 miles to Piper Creek. Limitations of past mapping technology resulted in the misidentification of the Town Branch headwater. Thus, the impaired segment of Town Branch addressed in this revised TMDL includes a 1.2-mile unnamed tributary and a 1.5-mile segment of Town Branch that together are identified as WBID 3822. This revised TMDL also includes a 5.3-mile segment of Piper Creek (WBID 1444) from the Pomme de Terre River to the confluence with Town Branch. The total length of the impaired segments addressed in this revised TMDL is 7.8 miles. In addition to receiving effluent from the Bolivar Wastewater Treatment Facility, WBID 3822 receives stormwater from the 8.3 square mile area of the City of Bolivar. In addition to urban stormwater inputs from Town Branch, Piper Creek also receives a substantial portion of its flow via runoff from pasture lands (see Section 3.4 and Table 5 for additional land use detail). The locations of Town Branch, Piper Creek, and the impaired stream segment are presented on Figure 1.

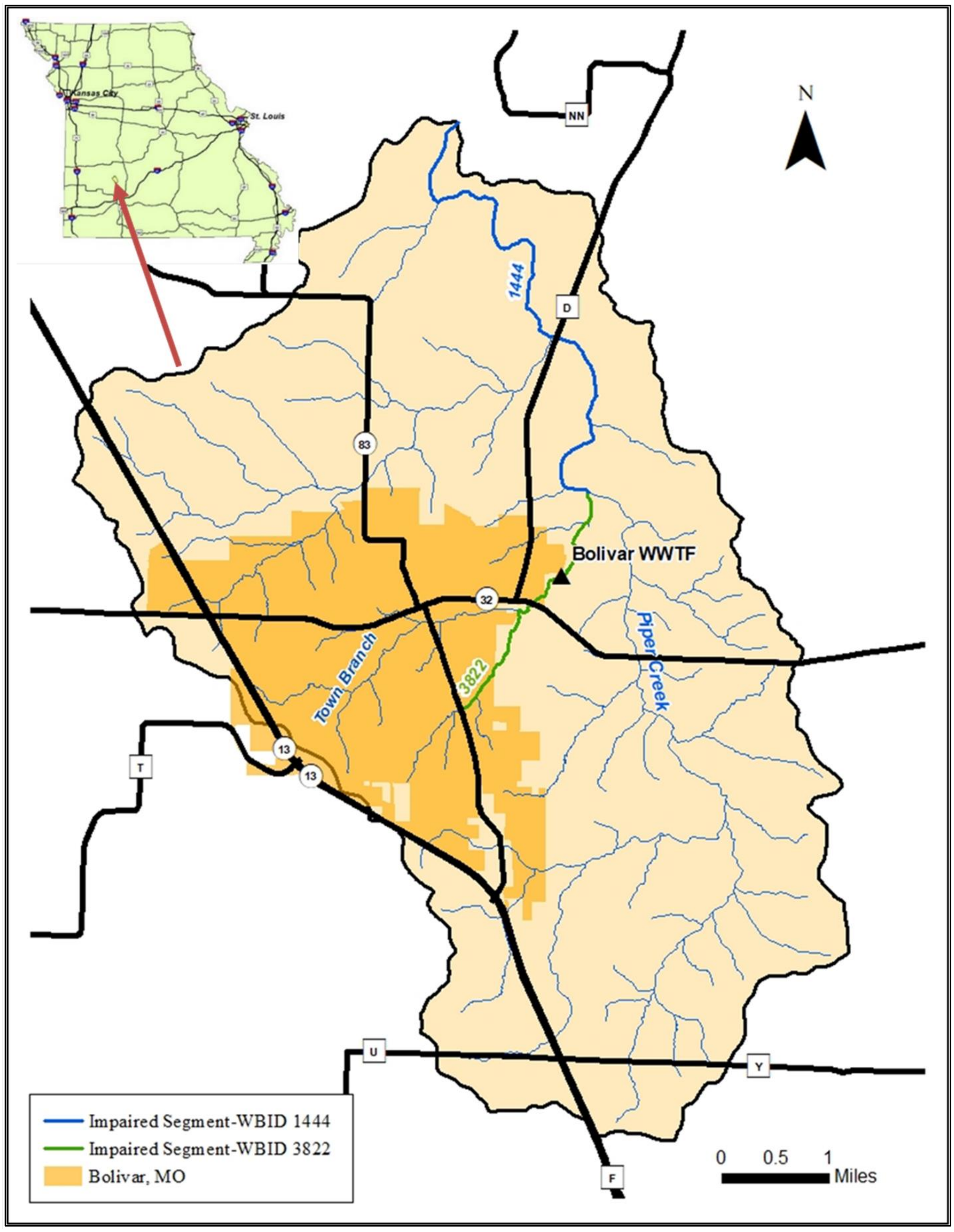

Figure 1. Piper Creek Watershed, 12-digit HUC 102901070303

3.1 Geology, Physiography and Soils

The Piper Creek watershed is located within the Osage ecological drainage unit (EDU). Ecological drainage units are groups of watersheds that have similar biota, geography, and climate characteristics (USGS 2009). The Osage EDU encompasses the lower portion of the Osage River watershed. The Piper Creek watershed is within the Springfield Plain, which is characterized by cherty Mississippian limestones with Pennsylvanian sandstone and shale deposits that form ridges that rise above a generally flat plain. The predominance of limestone in the watershed results in high groundwater contributions to streams, numerous springs, and abundant karst features. Soils are typically moderately-deep, fine-textured loams and silt loams covered by a thin layer of loess. Streams typically have moderate gradients and are spring-influenced, with clear water underlain by chert gravel and cobble that form well-defined riffles (MoRAP 2005).

The Piper Creek watershed is also located in the Central Plateau area of the Ozark Highlands Level IV Ecoregion. Ecoregions are areas with similar ecosystems and environmental resources and are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. By recognizing spatial differences in ecosystems, ecoregions stratify the environment by its probable response to disturbance (Chapman et al. 2002). Ecoregions are further defined in Missouri's Water Quality Standards at 10 CSR 20-7.031(1)(H). Streams flowing across the Ozarks Highlands ecoregion have dissected it into a large number of small plateaus. Natural vegetation is tallgrass prairie, savanna, and post-oak woodlands. The majority of the land has been cleared, and is used for pasture. There are large areas of clay and sandy soils, including sinks filled with Pennsylvanian clay that is mined for fire clay (Chapman et al. 2002).

As presented in Table 1, the predominant soils in the Piper Creek watershed consist of silt loam. Although soil types in the watershed vary, they can be categorized into hydrologic soil groups based on similar runoff potentials. A hydrologic soil group indicates the rate at which water enters the soil profile under conditions of a bare, thoroughly wetted soil surface, which in turn may affect the potential amount of water entering the stream as runoff (NRCS 2009). Group A represents soils with the highest rate of infiltration and the lowest runoff potential. Group D soils have the lowest rate of infiltration and the highest potential for runoff. Group C soils have a low-moderate rate of infiltration and a moderate-high potential for runoff. Dual soil groups (e.g., C/D) account for the presence of a high water table by providing both the drained and undrained condition of the soil. Table 2 provides a summary of the hydrologic soils groups in the Piper Creek watershed and Figure 2 shows their distribution. There are no Group A soils in the Piper Creek watershed.

Table 1. Predominant Soil Types in the Piper Creek Watershed (NRCS 2017)

Soil Type	Description (percent slope)	Characteristics	Hydrologic Soil Group	Percentage of Watershed (%)
Viraton silt loam	2-5	Moderately well drained soils on fragipan upland woodland	D	15.1
Creldon silt loam	1-3	Moderately well drained soils on chert upland prairie	C	12.5
Bolivar loam	3-8	Well drained soils on dry sandstone upland woodland	C	10.5
Hoberg silt loam	2-5	Moderately well drained soils on chert upland prairie	C	9.1
Pomme silt loam	3-8	Well drained soils on loamy footslope forest	B	5.7
Racket silt loam, frequently flooded	1-3	Well drained soils on loamy floodplain step forest	B	4.0
Plato silt loam	1-3	Somewhat poorly drained soils on fragipan upland flatwoods	D	2.6

Table 2. Summary of Hydrologic Soil Groups in the Piper Creek Watershed (NRCS 2009)

Hydrologic Soil Group	Area (mi^2)	Area (%)
Not Rated (Open Water)	0.06	0.16
B	6.28	16.92
C	18.15	48.91
C/D	2.00	5.39
D	10.62	28.62
Total	37.11	100.00

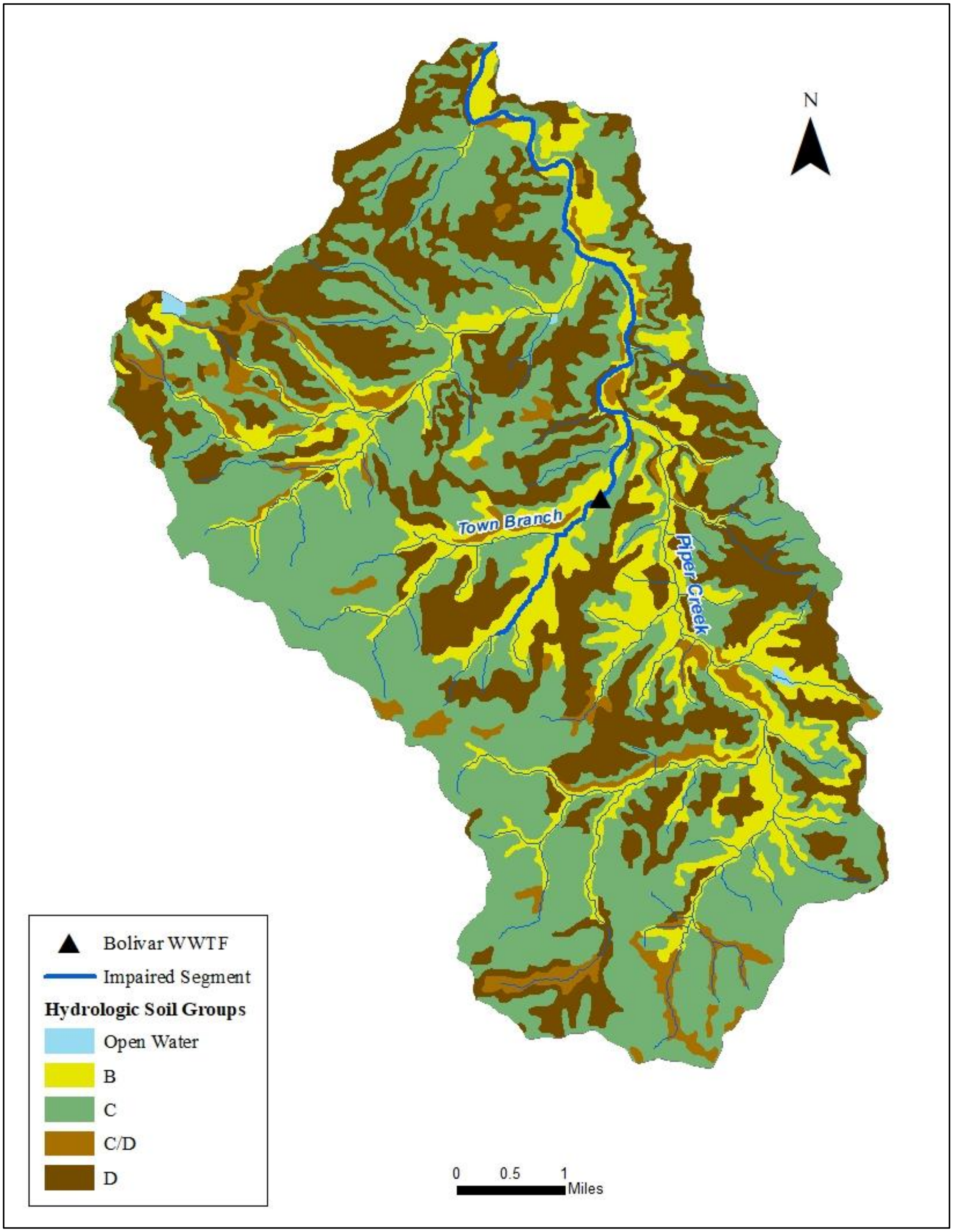

Figure 2. Hydrologic Soil Groups in the Piper Creek Watershed, 12-digit HUC 102901070303

3.2 Climate

Climate normals are 30-year averages of climatological variables, including temperature and precipitation, produced by the National Centers for Environmental Information every 10 years (NOAA 2010). The monthly precipitation and temperature normals are calculated using daily weather data from the Springfield Regional Airport (Station No. USW00013995) and are representative of the climatic conditions in the Piper Creek watershed. Of the various climatic factors, precipitation is especially important as it is related to stream flow and runoff events that can influence the transport of pollutants from nonpoint sources into streams. Water quality data recorded in 2013 and stream condition observations documented in 2018 were used to for this revised TMDL. Table 3 and Figures 3-5 compare 2013 and 2018 temperature and precipitation data with the 30-year climate normal rainfall and temperature data observed at Springfield Regional Airport. The U.S. Drought Monitor (University of Nebraska 2019) determined that the Pomme de Terre 8-digit HUC was not in drought in 2013, but experienced drought conditions in most of 2018. Annual precipitation in 2018 was 15 percent less than 2013.

Table 3. Comparison of Climate Normals, 2013, and 2018 Data at the Springfield Regional Airport Weather Station No. USW00013995 (NOAA 2010)

	Precipitation (inches)			**Max. Temp. (°F)**			**Min. Temp. (°F)**		
Month	Normal	2013	2018	Normal	2013	2018	Normal	2013	2018
January	2.47	3.06	1.96	42.9	47.4	43.0	22.4	25.9	20.3
February	2.52	2.28	7.57	48.2	45.9	50.4	26.1	27.7	28.3
March	3.62	4.77	3.61	57.5	51.7	58.5	35.2	31.5	36.3
April	4.32	5.64	2.27	67.2	65.7	62.9	44.3	42.6	39.1
May	5.10	7.97	2.82	75.3	73.7	84.3	54.4	53.9	62.4
June	4.85	2.26	4.32	83.8	83.6	90.5	63.1	63.8	69.2
July	3.68	6.33	1.04	88.8	86.8	91.4	67.6	66.7	69.4
August	3.55	5.84	6.71	89.0	85.4	87.7	66.6	67.3	68.1
September	4.61	2.18	4.09	80.3	83.1	81.6	57.7	60.8	63.6
October	3.59	6.93	3.57	69.0	66.9	67.9	46.5	46.7	48.9
November	4.22	2.02	2.76	56.7	53.9	49.8	35.4	33.4	29.6
December	3.04	2.56	3.07	44.9	42.6	46.5	25.0	22.0	29.4
	Total			**Average**			**Average**		
	45.6	51.8	43.8	67.0	65.6	67.9	45.4	45.2	47.1

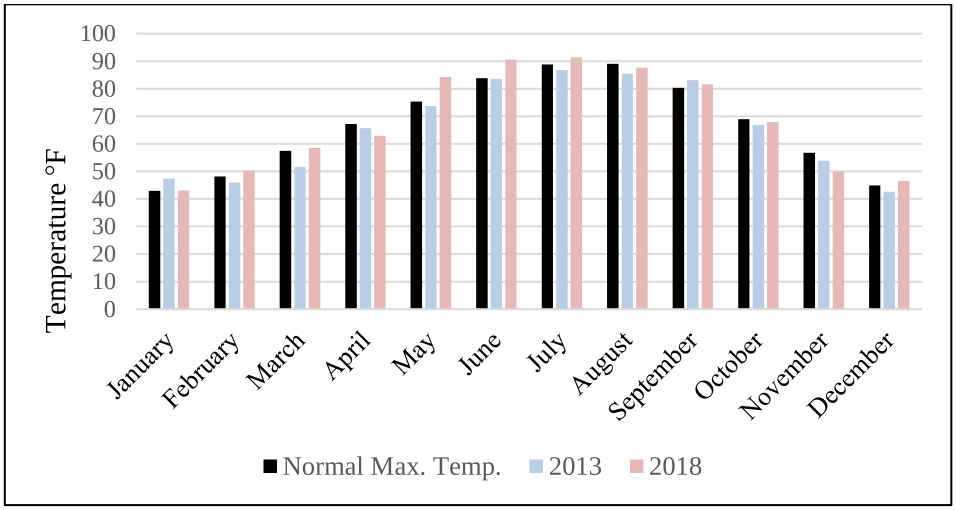

Figure 3. Comparison of Climate Normal, 2013 and 2018 Average Monthly Maximum Temperatures

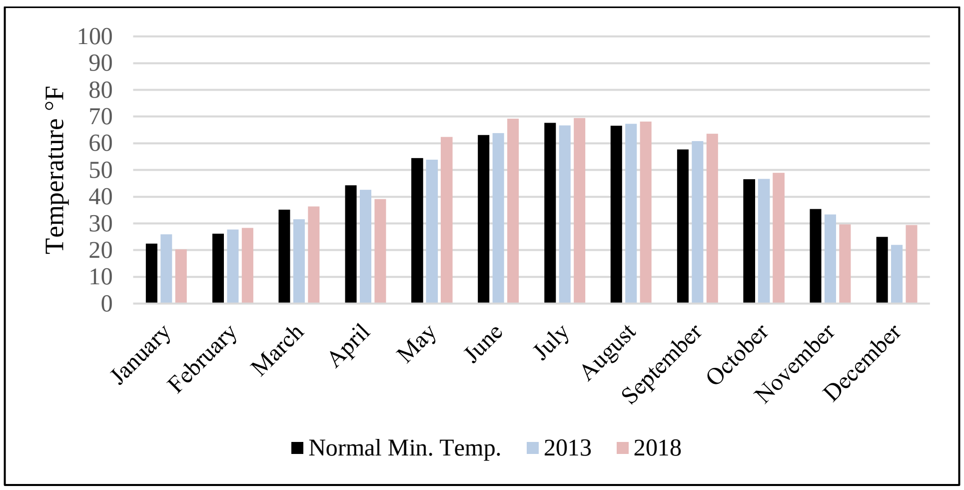

Figure 4. Comparison of Climate Normal, 2013, and 2018 Average Monthly Minimum Temperatures

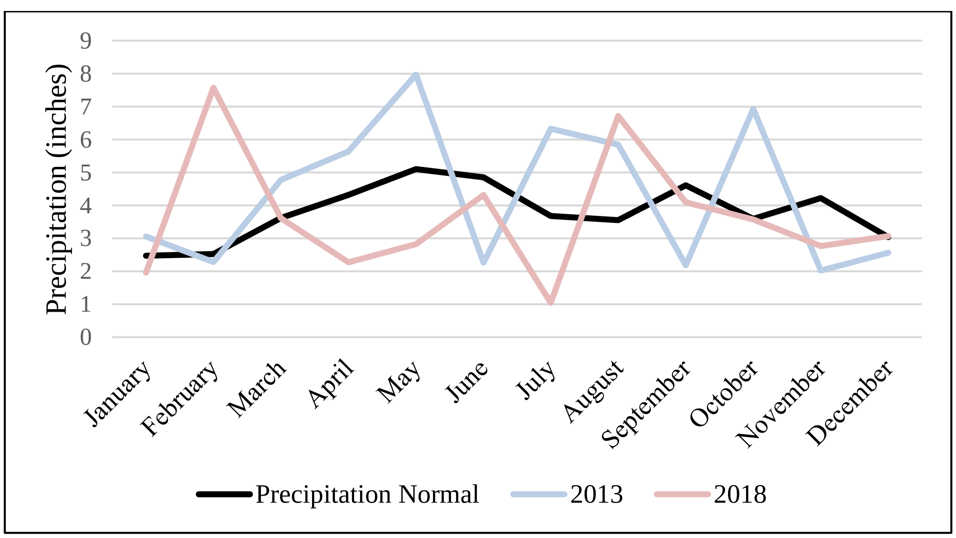

Figure 5. Comparison of Climate Normal and 2018 Average Monthly Precipitation

3.3 Population

The population estimates presented in Table 4 were derived using GIS software and superimposing the watershed boundary over a map of census blocks (Figure 6). Wherever the centroid of a census block fell within a watershed boundary, the entire population of the census block was included in the total. If the centroid of the census block was outside the boundary, then the population of the entire block was excluded. Using a similar method, the municipal population was estimated by superimposing municipal areas over the map of census blocks.

Table 4. Population Estimates for the Piper Creek Watershed

Municipal Population			Rural Population			Total Population		
1990	2000	2010	1990	2000	2010	1990	2000	2010
7,072	9,070	10,198	1,724	2,121	2,678	8,796	11,191	12,876

The U.S. Census Bureau (2010) estimated the population in the City of Bolivar to be 10,198 in 2010. Of the 8.3 square mile municipal boundary, 7.9 square miles are within the Piper Creek watershed. Population growth between 1990 and 2010 was approximately 32 percent in the Piper Creek watershed.

Demographic data from the U.S. Census Bureau is included in EPA's web-based EJSCREEN tool and may be used to identify areas in the watershed with potential environmental justice concerns. The EJSCREEN tool is available at https://www.epa.gov/ejscreen. EPA defines environmental justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 2014a). Communities determined to have environmental justice concerns may qualify for financial and strategic assistance for addressing environmental and public health issues. One example of financial assistance the Department offers that may be available to areas having environmental justice concerns is Section 319 grant funding to address nonpoint sources. The Department evaluates 319 grants on a number of criteria, but gives higher priority for selection to proposed projects in disadvantaged communities. Additional grant and financial resource information is available on EPA's environmental justice website at www.epa.gov/environmentaljustice.

The EJSCREEN tool integrates 11 environmental pollution indicators, 6 demographic indicators, and a demographic index based on percent low income and percent minority. EJSCREEN results highlight places that may be candidates for further review, analysis, or outreach to support EPA's environmental justice work. Information on the development, limitations, and intended uses of EJSCREEN, as well as access to the mapping tool can be found at the EJSCREEN website.

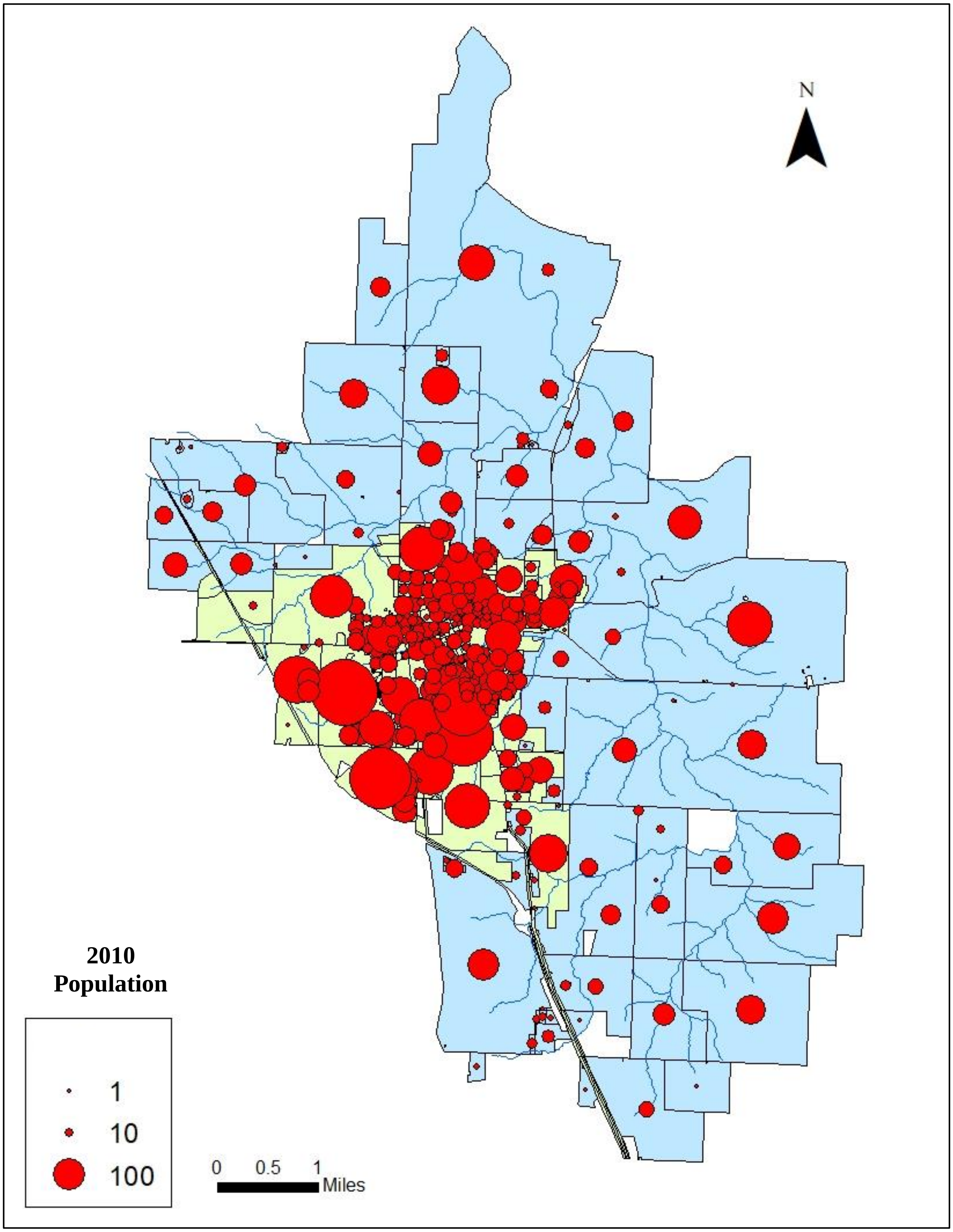

Figure 6. Population Density in the Piper Creek Watershed, 12-digit HUC 102901070303

3.4 Land Cover

A land cover analysis was completed using the 2011 National Land Cover Database (NLCD) published by the USGS (Homer et al. 2015). Land cover area in the Piper Creek watershed is summarized in Table 5. Pasture land covers 56 percent (20.8 square miles) of the Piper Creek watershed, the majority of which (19.6 square miles) drains directly to Piper Creek. Developed area covers approximately 19.6 percent (7.3 square miles) of the Piper Creek watershed. The developed areas primarily drain to the unnamed tributary and Town Branch, which together are identified in Missouri's Water Quality Standards as "Town Branch" WBID 3822 (Figure 7). The Town Branch subwatershed is 5.5 square miles and developed areas constitute approximately 65 percent of the subwatershed. Impervious surfaces associated with the developed land cover types ranges from less than 20 percent to greater than 79 percent. Stream degradation associated with impervious surfaces has been shown to first occur at about 10 percent impervious and increases in severity as imperviousness increases (Arnold and Gibbons 1996; Schueler 1994). The predominance of hay and pasture lands (56 percent) coupled with the predominance of soils with high runoff potential (Table 2) increase the likelihood of sediment and nutrient transport from nonpoint sources (i.e., overland flow) into Piper Creek. The predominance of imperviousness in the Town Branch watershed may also play some role in the impairment of that segment.

Table 5. Land Cover in the Piper Creek Watershed (NLCD, 2011)

Land Cover	Acres	Square Miles	Percent (%)
Barren Land	26	0.04	0.11
Cultivated Crops	396	0.62	1.67
Developed, High Intensity	228	0.36	0.96
Developed, Low Intensity	2,232	3.49	9.40
Developed, Medium Intensity	705	1.10	2.97
Developed, Open Space	1,477	2.31	6.22
Forest	4,837	7.56	20.37
Hay and Pasture	13,298	20.80	56.01
Open Water	31	0.05	0.13
Shrub and Herbaceous	458	0.72	1.93
Wetlands	53	0.08	0.22
Total	23,741	37.13	100.0

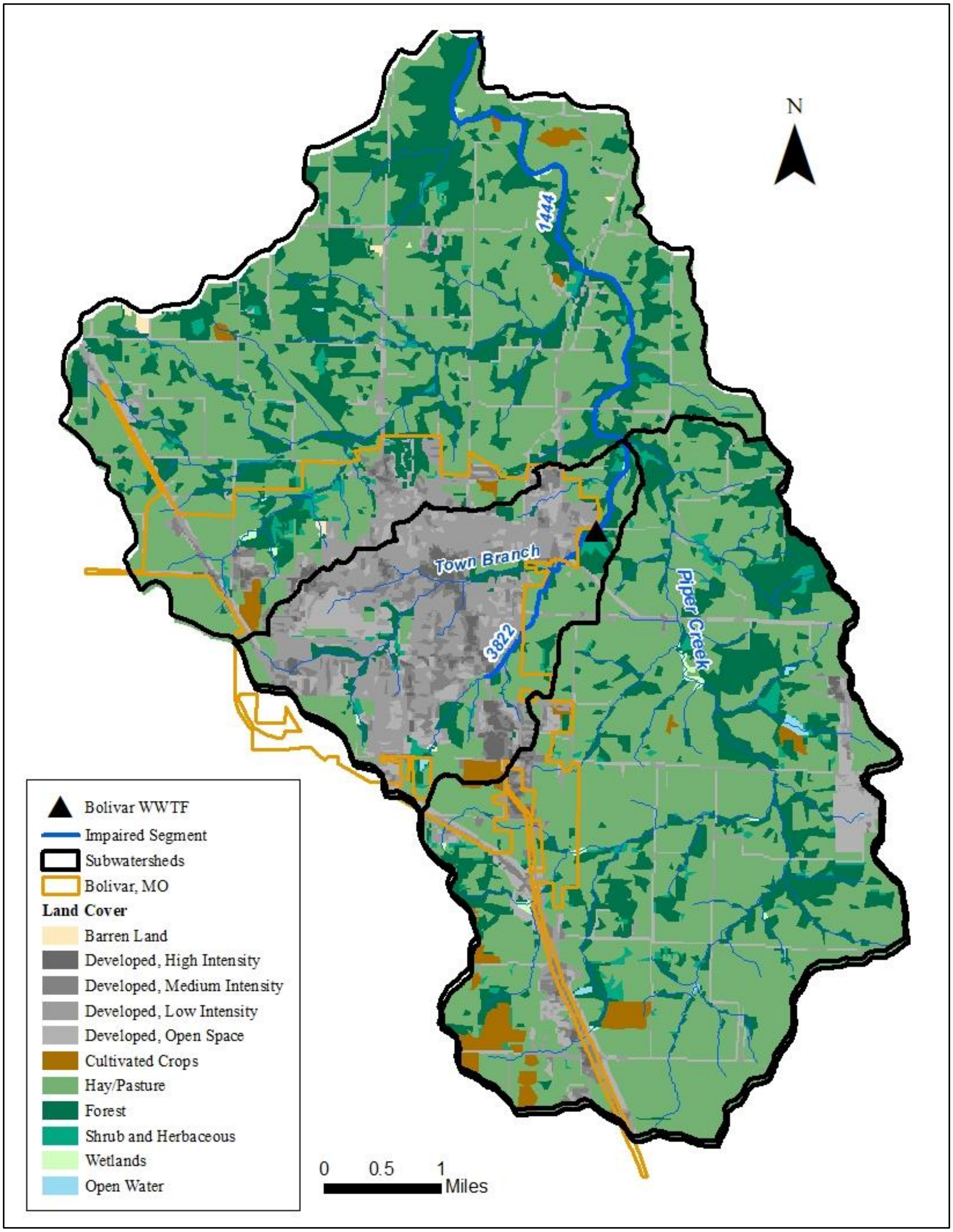

Figure 7. Land Cover in the Piper Creek Watershed, 12-digit HUC 102901070303

4. Applicable Water Quality Standards

The purpose of developing a TMDL is to identify the maximum pollutant loading that a water body can assimilate and still attain and maintain water quality standards. Water quality standards are therefore central to the TMDL development process. Under the federal Clean Water Act, every state must adopt water quality standards to protect, maintain, and improve the quality of the nation's surface waters (U.S. Code Title 33, Chapter 26, Subchapter III). Water quality standards consist of three major components: designated uses, water quality criteria, and an antidegradation policy.

Per federal regulations at 40 CFR 131.10, the designated uses and criteria to protect those uses assigned to a water body shall provide for the attainment and maintenance of the water quality standards of downstream waters. The components of Missouri's Water Quality Standards discussed in this section meet these requirements and have been approved by EPA. It is not the purview of a TMDL to revise existing water quality standards. In the event that future water quality monitoring demonstrates that water quality standards are not protective of downstream uses, the federal Clean Water Act provides means to address the situation. Such means are described in EPA's Water Quality Standards Handbook.[5]

4.1 Designated Uses

Designated uses for a water body are defined in Missouri's Water Quality Standards at 10 CSR 20-7.031(1)(C) and assigned per 10 CSR 20-7.031(2) and Table H. These uses must be maintained in accordance with the federal Clean Water Act. Piper Creek and Town Branch have been assigned the following designated uses as described in Table H of 10 CSR 20-7.031:

- Irrigation;
- Livestock and wildlife protection;
- Human health protection;
- Warm water habitat (aquatic life);
- Whole body contact recreation Category B; and
- Secondary contact recreation.

Town Branch and Piper Creek are impaired due to nonattainment of the warm water habitat (aquatic life) use due to violations of Missouri's general criteria.

4.2 Water Quality Criteria

Water quality criteria are limits on certain chemicals or conditions in a water body to protect particular designated uses. Water quality criteria can be expressed as general narrative statements or specific numeric criteria. Missouri Water Quality Standards at 10 CSR 20-7.031(4) and (5) establish General Criteria applicable to all waters of the state at all times and Specific Criteria applicable to waters contained in 10 CSR 20-7.031 Tables G (Lakes) and H (Streams), respectively. Available data and field observations note water quality violations of general criteria associated with organic sediment (sludge) loading, excessive benthic and sestonic algae, and impairments to the benthic macroinvertebrate community.

[5] https://www.epa.gov/wqs-tech/water-quality-standards-handbook

Excessive sediment deposition, either organic or inorganic, that results in bottom deposits that harm aquatic life or otherwise prevent the full maintenance of beneficial uses are violations of the general criteria specified at 10 CSR 20-7.031(4)(A) and (C).

The ultimate endpoint for this revised TMDL will be to meet Missouri Water Quality Standards through attainment of the general criteria such that waters are free from excessive sedimentation and unsightly color or turbidity, and the warm water habitat (aquatic life) designated use is restored. Compliance with these criteria will be determined in accordance with Department assessment procedures for federal Clean Water Act sections 305(b) and 303(d) reporting.

4.3 Antidegradation Policy

Missouri's Water Quality Standards include the EPA "three-tiered" approach to antidegradation, and may be found at 10 CSR 20-7.031(3).

Tier 1 – Protects public health, existing instream water uses and a level of water quality necessary to maintain and protect existing uses. Tier 1 provides the absolute floor of water quality for all waters of the United States. Existing instream water uses are those uses that were attained on or after November 28, 1975, the date of EPA's first Water Quality Standards Regulation.

Tier 2 – Protects and maintains the existing level of water quality where it is better than applicable water quality criteria. Before water quality in Tier 2 waters can be lowered, there must be an antidegradation review consisting of: (1) a finding that it is necessary to accommodate important economic and social development in the area where the waters are located; (2) full satisfaction of all intergovernmental coordination and public participation provisions; and (3) assurance that the highest statutory and regulatory requirements for point sources and best management practices for nonpoint sources are achieved. Furthermore, water quality may not be lowered to less than the level necessary to fully protect "fishable/swimmable" uses and other existing uses.

Tier 3 – Protects the quality of outstanding national and state resource waters, such as waters of national and state parks, wildlife refuges and waters of exceptional recreational or ecological significance. There may be no new or increased discharges to these waters and no new or increased discharges to tributaries of these waters that would result in lower water quality.

Waters in which a pollutant is at, near, or exceeds the water quality criteria are considered in Tier 1 status for that pollutant. Therefore, the antidegradation goals for Town Branch and Piper Creek are to restore water quality to levels that meet the water quality standards.

5. Defining the Problem

Town Branch and portions of Piper Creek are impaired due to violations of Missouri's general water quality criteria for the protection of warm water aquatic life and natural biological aquatic communities. Both streams were placed on the 303(d) list under the name "Piper Creek" due to observations of objectionable solids downstream of the Bolivar Wastewater Treatment Facility. Piper Creek remains impaired due to organic sediments from the Bolivar facility and "unknown" pollutants and sources.

Biological Assessment studies were conducted in the vicinity of the Bolivar Wastewater Treatment Facility in 2003-2004, and again in 2015-2016. The 2003-2004 study found that the benthic

macroinvertebrate communities in Town Branch and Piper Creek were impaired, and resulted in the "unknown" impairment listing of "Piper Creek (Town Branch)" on the 2008 303(d) list. The 2015-2016 study found only minimal improvement in the benthic macroinvertebrate community along the impaired segment. These water quality studies also noted excessive benthic algae in these streams, which can contribute to the conditions impairing the macroinvertebrate community.

When present in excessive quantities, benthic algae growths can cause drops in dissolved oxygen concentrations that harm aquatic life. Although low dissolved oxygen conditions have not been observed in Town Branch or Piper Creek, other indications of excessive algae growth have been noted such as visual observations, high measurements of chlorophyll-a, and large daily fluctuations of dissolved oxygen concentrations. Daily fluctuations in dissolved oxygen concentrations can result from daily changes in respiration and photosynthesis (Nimick et al. 2003). Large fluctuations of dissolved oxygen concentrations greater than 4 milligram per liter (mg/L) have been shown to reduce diversity and negatively impact aquatic macroinvertebrate communities (MPCA 2008). Available data collected from Town Branch and Piper Creek in 2013 do show wide fluctuations between early morning and midday dissolved oxygen concentrations (Table 6). This data reflects data collection prior to the expected afternoon peak in dissolved oxygen concentrations, which in Missouri typically occurs around 2 p.m. It is therefore likely that daily fluctuations in dissolved oxygen concentrations in Town Branch and Piper Creek are wider than available data suggest. For this reason, wide daily fluctuations in dissolved oxygen concentrations associated with excessive benthic algae growth are suspected to be the primary factor contributing to the "unknown" biological impairments of Piper Creek and Town Branch.

Table 6. 2013 Dissolved Oxygen Data

WBID	Site Description	Date	Time	DO (mg/L)	DO Fluctuation (mg/L)
1444	1.5 miles below Bolivar WWTP	7/9/2013	6:20	5.76	4.96
	1.5 miles below Bolivar WWTP	7/9/2013	12:25	10.72	
	1.5 miles below Bolivar WWTP	8/21/2013	6:55	6.91	3.84
	1.5 miles below Bolivar WWTP	8/21/2013	11:35	10.75	
	1.5 miles below Bolivar WWTP	7/9/2013	5:45	6.04	5.13
	1.5 miles below Bolivar WWTP	7/9/2013	11:40	11.17	
	1.5 miles below Bolivar WWTP	8/21/2013	6:30	7.18	6.86
	1.5 miles below Bolivar WWTP	8/21/2013	11:10	14.04	
3822	0.2 miles downstream of 435th Rd.	7/9/2013	6:25	6.61	3.1
	0.2 miles downstream of 435th Rd.	7/9/2013	11:35	9.71	
	0.2 miles downstream of 435th Rd.	8/21/2013	6:45	7.33	3.24
	0.2 miles downstream of 435th Rd.	8/21/2013	11:30	10.57	
	At Highway 32	7/9/2013	6:05	7.38	3.66
	At Highway 32	7/9/2013	11:55	11.04	
	At Highway 32	8/21/2013	6:15	8.31	2.55
	At Highway 32	8/21/2013	12:00	10.86	

Piper Creek was listed as impaired for non-filterable residue in 1998, and this listing was modified to volatile suspended solids on the 2002 Missouri 303(d) List. The Department collected sediment

data upstream and downstream of the Bolivar Wastewater Treatment Facility and on Piper Creek upstream and downstream of Town Branch in March 2004, May 2004, July 2005, and March 2006. As summarized in Table 7, the stream sediment data showed a substantial increase in the average biochemical oxygen demand (BOD), total suspended solids (TSS), volatile suspended solids (VSS), and percent fine sediment (<2 mm) deposition downstream of the Bolivar Wastewater Treatment Facility. The stream sediment data also showed elevated BOD, TSS, VSS, and fine sediment in Piper Creek upstream of the confluence with Town Branch. As a result, "Piper Creek (Town Branch)" was also placed on the 2008 303(d) List as impaired by organic sediment. Organic sediment can reduce available habitat for aquatic life, contribute to excessive algae growth, and can be an additional stressor on instream dissolved oxygen concentrations.

Table 7. 2004-2006 Average Percent of Total Upstream and Downstream Sediment Characteristics and Percent Cover by Fine (<2 mm) Sediment 2004-2006

Sample Location	BOD %	TSS %	VSS %	Fine Sediment %
Town Branch				
Upstream of Bolivar WWTF	21.8	15.0	16.3	22.8
Downstream of Bolivar WWTF	78.2	85.1	83.7	92.7
Piper Creek				
Upstream of Town Branch	50.4	70.5	67.0	72.8
Downstream of Town Branch	49.6	29.5	33.0	69.4

The Regional Technical Assistance Group (RTAG) for the development of nutrient criteria in EPA Region 7 formed in 1999. The group consisted of state, federal, tribal, and academic members and developed nutrient benchmark concentrations (i.e., surrogate criteria) for streams in Missouri, Kansas, Nebraska, and Iowa (USEPA 2016). As stated in a memo issued by EPA Region 7's Water Division director on October 14, 2019, "EPA Region 7 considers the benchmark concentrations for streams to be consistent with the federal Clean Water Act and its implementing regulations at 40 CFR 131.11(a) as being protective of the designated uses and they are scientifically defensible nutrient criteria for flowing waters within the four states of Iowa, Kansas, Missouri, and Nebraska." In addition to RTAG nutrient benchmark values for TN and TP, the study identified "breakpoint" (i.e., threshold) values for macroinvertebrate richness. The RTAG benchmark and breakpoint values are presented in Table 8. Because Missouri does not currently have nutrient criteria for streams, the RTAG nutrient benchmarks are a useful point of comparison for designated use protection.

Table 8. Nutrient Concentrations from the 2016 RTAG Study

Metric	TN (mg/L)	TP (µg/L)
Breakpoint - Macroinvertebrate Richness	---	57
EPA Region 7 - Nutrients	0.900	75

The Department conducted water quality sampling along Town Branch and Piper Creek upstream and downstream of the Bolivar Wastewater Treatment Facility in 2013 and 2018. Sample point locations are presented in Figure 8. The results of these studies are presented in tabular (Table 9) and graphical (Figures 9 and 10) form below. The RTAG benchmarks have been superimposed on Figures 9 and 10 for comparison purposes only.

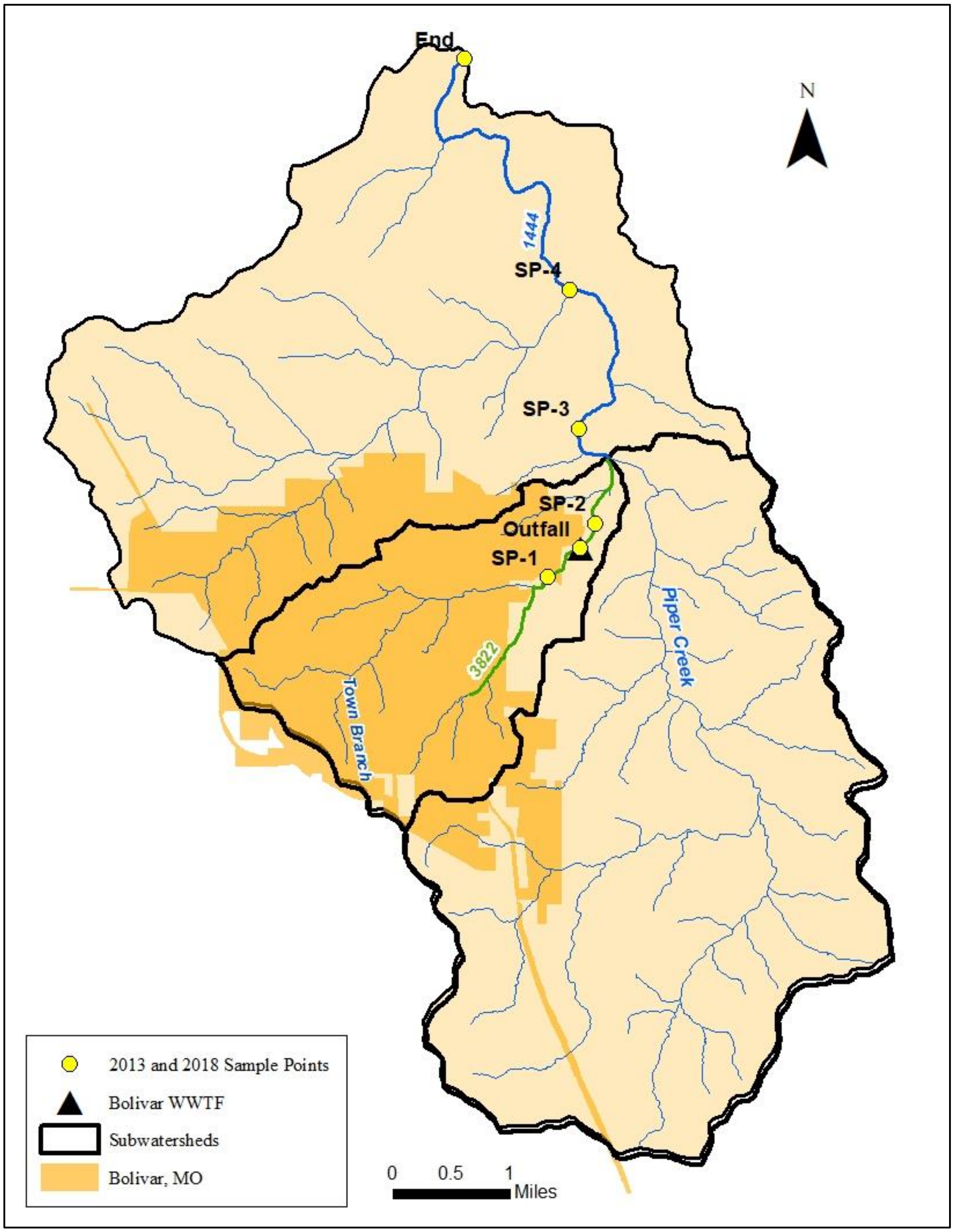

Figure 8. Town Branch and Piper Creek Water Quality Sample Sites

Table 9. Results of 2013 and 2018 Nutrient Sampling in Piper Creek and Town Branch

Sample Point	2013 TN (mg/L)	2018 TN (mg/L)	2013 TP (µg/L)	2018 TP (µg/L)
SP-1	2.44	1.78	20	No Data
WWTF	25.46	22.90	4,420	3,140
SP-2	11.78	13.65	2,160	1,240
SP-3	8.76	10.43	1,430	1,490
SP-4	7.30	7.00	1,000	1,150

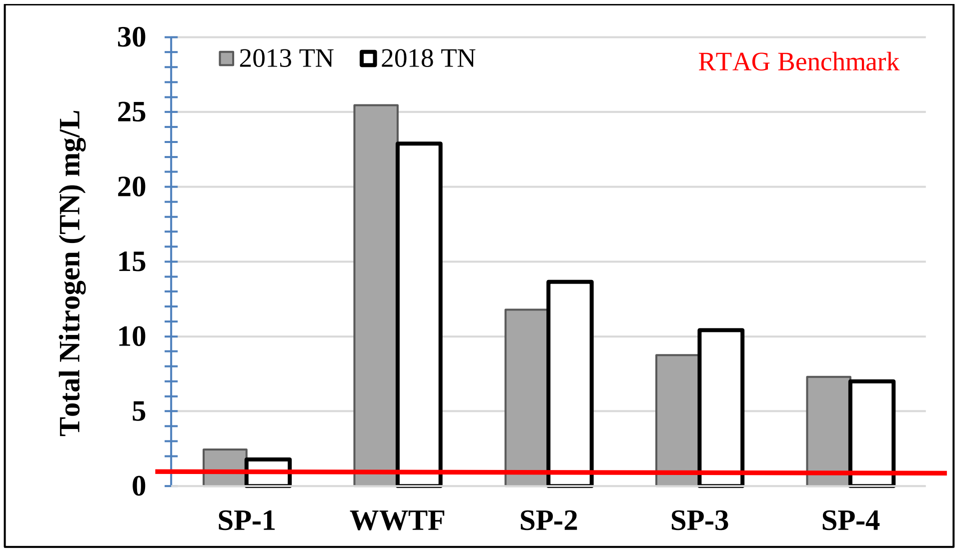

Figure 9. Total Nitrogen Concentrations along the Impaired Segment

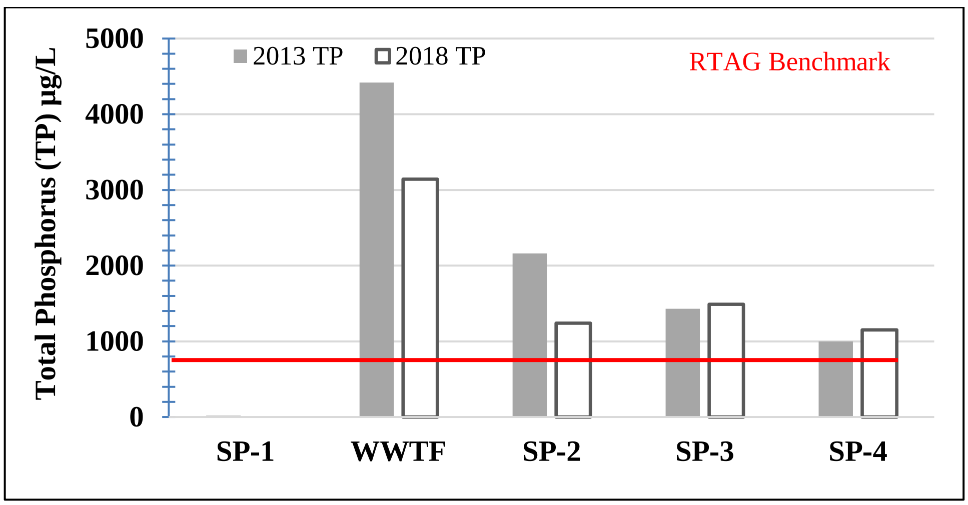

Figure 10. Total Phosphorus Concentrations along the Impaired Segment

It is important to note that the RTAG benchmarks can be applied to rivers and streams in Region 7, but are not appropriate limits for wastewater effluent. Reductions in point and nonpoint source nutrient and sediment loading are needed to improve the warm water habitat and nutrient attenuation capacity of Town Branch and Piper Creek.

6. Source Inventory and Assessment

Various sources may be contributing pollutant loading to Town Branch and Piper Creek that result in excessive organic sediment and benthic algae growth that, in turn, contribute to low benthic macroinvertebrate community diversity. For this reason, a source inventory and assessment is included in this TMDL report to identify and characterize any known, suspected, and potential sources of pollutant loading to Town Branch and Piper Creek. These sources are categorized as being either point (regulated) or nonpoint (unregulated).

6.1 Point Sources

Point sources are defined under Section 502(14) of the federal Clean Water Act and are typically regulated through the Missouri State Operating Permit program.[6] Point sources include any discernible, confined, and discrete conveyance, such as a pipe, ditch, channel, tunnel, or conduit, by which pollutants are transported to a water body. Under this definition, permitted point sources include permitted municipal and domestic wastewater dischargers, site-specific permitted industrial and non-domestic wastewater dischargers, concentrated animal feeding operations (CAFOs), Municipal Separate Storm Sewer Systems (MS4s), and general wastewater and stormwater permitted entities. In addition to these permitted sources, illicit straight pipe discharges, which are illegal and therefore unpermitted, are also point sources.

As presented in Figure 11, point sources in the Piper Creek watershed include 5 municipal and domestic wastewater treatment facilities with site-specific permits, 3 general permitted dischargers, and 11 permitted stormwater dischargers.[7] In addition to these permitted activities, stormwater discharges from the City of Bolivar are regulated through a small MS4 general permit. Likewise, stormwater discharges from highways and rights-of-way in Bolivar are regulated through a site-specific MS4 permit issued to the Missouri Department of Transportation (MoDOT). There are no CAFO or site-specific permitted industrial or non-domestic dischargers in the Piper Creek watershed.

[6] The Missouri State Operating Permit Program is Missouri's program for administering the federal National Pollutant Discharge Elimination System (NPDES) program. The NPDES program requires all point sources that discharge pollutants to waters of the United States to obtain a permit. Issued and proposed operating permits are available online at dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees

[7] Three facilities included in the original 2010 TMDL, Bolivar Farmers Exchange Fertilizer (MOR240033), Yeargain Steel and Salvage (MOR60A120), and Carl White Oil Co. (a.k.a. MFA Oil Bulk Plant-Bolivar), are no longer operating in the watershed and their permits have been terminated.

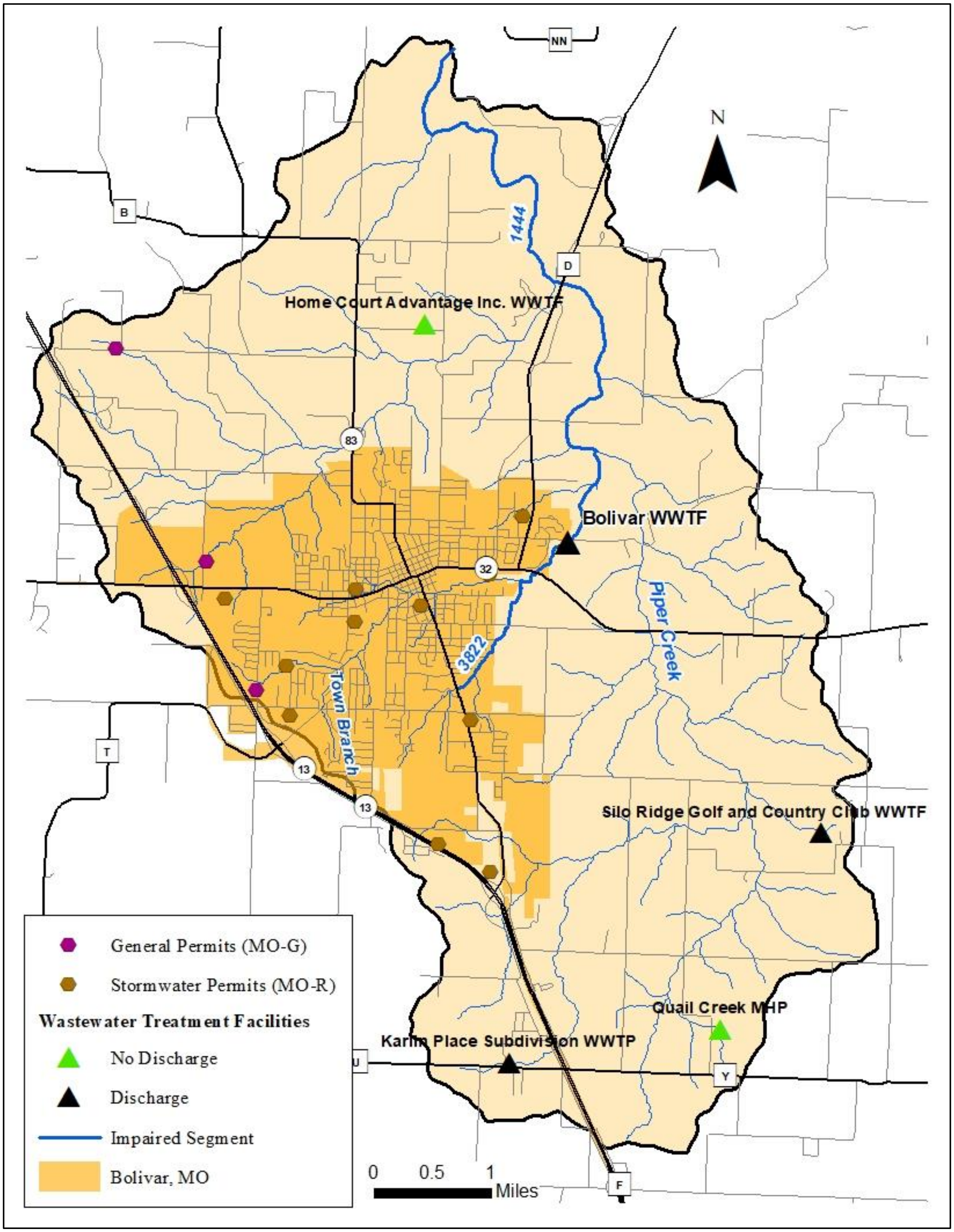

Figure 11. Point Sources in the Piper Creek Watershed

6.1.1 Municipal and Domestic Wastewater Discharge Permits

Dischargers of domestic wastewater include both publicly owned municipal wastewater treatment facilities and private non-municipal treatment facilities. Domestic wastewater is primarily household waste, including graywater and sewage. Untreated or inadequately treated discharges of domestic wastewater can be significant sources of BOD, nitrogen, and phosphorus to receiving waters. Influences of pollutant loading from domestic dischargers are typically most evident at low-flow conditions when stormwater influences are lower or nonexistent. The domestic wastewater treatment facilities listed in Table 10 are located in the Piper Creek watershed. Design flows are expressed in million gallons per day (MGD).

Table 10. Domestic Wastewater Treatment Facilities in the Piper Creek Watershed

Facilities[8]	Permit No.	Design Flow (MGD)	Expires
Bolivar WWTF	MO-0022373	2.55000	4/3/2013
Karlin Place Subdivision WWTF	MO-0121924	0.51000	6/30/2025
Quail Creek Mobile Home Park	MO-0116467	0.01395	6/30/2025

Bolivar Wastewater Treatment Facility

The Bolivar Wastewater Treatment Facility is a major municipal domestic wastewater treatment facility with a design flow of 2.55 MGD. Effluent from the Bolivar facility discharges directly to the Town Branch portion of the impaired segment. Water quality sampling, benthic macroinvertebrate studies, and stream sediment studies conducted on Town Branch and Piper Creek in 2004-2006, 2013, 2015-2016, and 2018 found low quality macroinvertebrate communities, elevated volatile (organic) and TSS, and excessive benthic algae downstream of the facility. During critical (i.e., 7Q10) low flows, effluent from the Bolivar facility may constitute 99.8 percent of the flow in Town Branch.

Nonpoint source loading in the Piper Creek watershed was estimated using the Spreadsheet Tool for Estimating Pollutant Load (STEPL) (USEPA 2014), and was compared to the potential loading from the Bolivar Wastewater Treatment Facility based on facility permit limits and design flow. Based on STEPL estimates, under the current permit limits and design flow, annual effluent nitrogen loading from the Bolivar Wastewater Treatment Facility has the potential to be equivalent to nonpoint source loading, and annual effluent phosphorus loading may be up to three times more than nonpoint source loading in the Piper Creek watershed, during low flow conditions.

Low Volume Wastewater Treatment Facilities

There are four minor non-municipal domestic wastewater treatment facilities in the Piper Creek watershed. These facilities contribute minor amounts of flow during low flow conditions in comparison to the Bolivar Wastewater Treatment Facility. Two of the facilities regularly report "no discharge" during summer months when critical low flow conditions are expected. The other two facilities discharge to tributaries of Piper Creek, but not Town Branch, and are greater than four miles upstream of the impaired segment. Additionally, there are no reported water quality standards violations or documented benthic algae growths downstream of these facilities. For these reasons,

[8] Home Court Advantage, Inc. permit number MO-0097594 and Silo Ridge Golf and Country Club permit number MO-0121754 have been terminated.

pollutant loading from these facilities is considered *de minimis*, and is not expected to cause or contribute to the impairments of Town Branch or Piper Creek.

In addition to the direct discharges from domestic wastewater treatment facilities, potential pollutant contributions may also occur from overflows occurring from the adjoining sanitary sewer system. A sanitary sewer system is a wastewater collection system designed to convey domestic, commercial, and industrial wastewater to the treatment facility. This system can include limited amounts of inflow and infiltration from groundwater and stormwater, but it is not designed to collect large amounts of runoff from precipitation events. Untreated or partially treated discharge from a sanitary sewer system is referred to as a sanitary sewer overflow. Sanitary sewer overflows may result from blockages, line breaks, and sewer defects that allow excess storm water and ground water to enter and overload the collection system. Additionally, sanitary sewer overflows can result from lapses in sewer operation and maintenance, inadequate sewer design and construction, power failures, and vandalism. Sanitary sewer overflows can occur during either dry or wet weather and at any point in the collection system including overflows from manholes or backups into private residences. Such overflows may discharge directly to nearby waterways, or may be restricted to terrestrial locations. These types of discharges are unauthorized by the federal Clean Water Act and should be rare and eliminated to the maximum extent possible.

According to a review of sanitary sewer overflow records, the Bolivar Wastewater Treatment Facility has reported overflows 153 times since 2014. The 153 reported overflows included some high precipitation events and associated stormwater runoff, which flooded manholes. Temporary stormwater inundation events may not contribute to impairments in Town Branch or Piper Creek. In accordance with 644.026.1.(15) RSMo and 40 CFR Part 122.41(e) the permittee is required to develop and implement a program for maintenance and repair of collection systems. This program is implemented through a special permit condition or schedule of compliance. Currently the City of Bolivar has an abatement order on consent with EPA to reduce inflow and infiltration of stormwater into the city’s sewer system, which contributes to occurrences of sanitary sewer overflows.

6.1.2 Site-Specific Industrial and Non-Domestic Wastewater Permits

Industrial and non-domestic facilities discharge wastewater resulting from non-sewage generating activities. At the time of this report, there are no site-specific industrial or non-domestic wastewater permits in the Piper Creek watershed.

6.1.3 Concentrated Animal Feeding Operation Permits

Concentrated animal feeding operations (CAFOs) are animal feeding operations that confine and feed or maintain more than 1,000 animal units for 45 days or more during any 12-month period. Facilities with fewer animal units may be permitted as CAFOs if discharges occur or other water quality issues are discovered per 10 CSR 20-6.300. In Missouri, these types of facilities are permitted with either a site-specific permit or one of two available CAFO general permits. At the time of this report, there are no CAFOs in the Piper Creek watershed.

6.1.4 Municipal Separate Storm Sewer System (MS4) Permits

An MS4 is a stormwater conveyance system owned by a public entity that is not a combined sewer or part of a sewage treatment plant. Federal regulations issued in 1990 require discharges from such systems to be regulated by permits if the population of a municipality, or in some cases a county, is 100,000 or more. In 1999, new federal regulations required permits for discharges from small MS4s that are located within a U.S. Census Bureau defined urban area, or have otherwise been designated

as needing a permit by the permitting authority. Pollutant loading from these areas would be similar to nonpoint sources occurring through stormwater runoff (e.g., fertilizers from lawns, erosion, and yard debris), and potentially from sanitary sewer overflows entering the system. Although stormwater discharges are often untreated, MS4 permit holders must develop, implement, and enforce stormwater management plans to reduce the contamination of stormwater runoff and prohibit illicit discharges. These plans must include measurable goals, be reported on annually, and meet six minimum control measures. These six minimum control measures are public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention.

There are two MS4 permits in the Piper Creek watershed (Table 11). Stormwater discharges from the City of Bolivar are regulated through a general small MS4 stormwater permit. Stormwater discharges from highways and rights-of-way managed by MoDOT in Bolivar are regulated through a site-specific permit. The site-specific permit is applicable to all MoDOT maintained highways and rights-of-way in MS4 urban areas statewide and is commonly referred to as a transportation separate storm sewer system (TS4).

Table 11. Permitted MS4s in the Piper Creek Watershed

Facility	Permit No.	Expires
Bolivar Small MS4	MO-R04C054	9/30/2026
MoDOT TS4	MO-0137910	10/31/2026

Urban stormwater runoff can contain high levels of nitrogen and phosphorus that may result in nutrient loading to streams, which can contribute to excess algae growth and low dissolved oxygen conditions. During low precipitation and critical low flows, nutrients originating from fertilizer placed on residential lawns, cemeteries, parks, and other vegetated areas may be transported into storm sewers via runoff from sprinkler irrigation. Hobbie et al. (2017) found that pet (dog) waste may contribute 76 percent of TP inputs and 28 percent of TN inputs in urban areas. Hobbie et al. (2017) also found that export of phosphorus contributes 32 to 68 percent of storm drain nutrient outputs. Phosphorus transport is especially high in urban areas due to impervious surfaces which inhibit infiltration of soluble phosphorus and the phosphorus-laden runoff is carried to storm drains. In contrast, nitrogen transport is inhibited by up to 83 percent retention in unfertilized parks and storm drain catch basins and pipes.

The Bolivar municipal area accounts for 21.3 percent of the total Piper Creek watershed area. The vast majority of the municipal area, like many urban areas, is considered developed land, which includes areas that are 20 to 80 percent impervious (Section 3.4). Degradation of water quality associated with imperviousness typically occurs in watersheds with at least 10 percent total imperviousness (Arnold and Gibbons 1996; Schueler 1994). The portion of Town Branch upstream of the Bolivar Wastewater Treatment Facility collects urban runoff from 82 percent of the Bolivar municipal area. Water quality impairments, including visual observations of excessive algae and low quality macroinvertebrate communities, have been observed in Town Branch upstream of the Bolivar Wastewater Treatment Facility. Water quality data from 2013 show wide variation between morning and afternoon dissolved oxygen concentrations, as well as high chlorophyll-a concentrations, which are indicators of high algal productivity. Algae are evident in site photos taken upstream of the Bolivar facility. The Bolivar MS4 may also contribute pollutants to the impaired segment of Town Branch during critical low-flow conditions. Such contributions likely

result from the transport of nutrients from residential activities such as lawn irrigation and car washing.[9]

The area potentially contributing runoff to the MoDOT TS4 in Bolivar is 0.62 square miles and is comprised primarily of highways. This accounts for only 1.7 percent of the total watershed area. Due to the small amount of area draining to the TS4, and the lack of sources likely to contribute significant amounts of sediment or nutrients, the MoDOT TS4 does not cause or contribute to the impairment of Town Branch or Piper Creek.

6.1.5 General Wastewater and Non-MS4 Stormwater Permits

General and stormwater permits are issued based on the type of activity occurring and are intended to be flexible enough to allow for ease and speed of issuance, while providing the required protection of water quality. General and stormwater permits are issued for activities similar enough to be covered by a single set of requirements and are designated with permit numbers beginning with MO-G or MO-R, respectively.

Three facilities in the Piper Creek watershed operate under the general permit MO-G49 “Stormwater and other specified discharges from limestone and other rock quarries, concrete, glass, and asphalt industries,” as presented in Table 11.

Table 12. General Permits in the Piper Creek Watershed

Permit No.	Facility Name	Expires
MO-G490164	AGA 495 Bolivar Quarry	4/30/2022
MO-G490263	Bolivar Ready Mix and Materials, Inc.	4/30/2022
MO-G490247	Ewing Concrete Materials	4/30/2022

Facilities in the Piper Creek watershed operating under stormwater permits are presented in Table 13. Permits associated with construction or land disturbance activities (MO-RA) are temporary. The number of effective permits of this type may vary widely in any given year. Despite this variability, final TMDL targets and allocations do not vary as a result of any changes in the numbers of these types of permits.

Table 13. Stormwater Permits in the Piper Creek Watershed

Permit No.	Facility Name	Activity	Expires
MO-R100045	City of Bolivar	Land Disturbance by City or County	6/22/2022
MO-R203498 formerly MO-R203016	Tracker Marine Bolivar	Fabricated Metal/Light Industrial	8/31/2024
MO-R240221	Hawk Fertilizer	Agrochemical Facilities	4/30/2024
MO-RA10636	University Plaza	Construction or Land Disturbance	2/7/2022
MO-RA11043	Southtown Sewer Ext - S.Hwy 83 Water Ext	Construction or Land Disturbance	2/7/2022
MO-RA11717	Mercy Clinic - Bolivar	Construction or Land Disturbance	2/7/2022

[9] Missouri’s general MS4 permit allows various non-stormwater discharges including, but not limited to, irrigation, street wash water, residential car washing, residential swimming pool discharges, and air conditioning condensate.

Permit No.	Facility Name	Activity	Expires
MO-RA12445	Dollar General No. 19947 Bolivar	Construction or Land Disturbance	2/7/2022
MO-RA12713	Hurricane Bay Car Wash	Construction or Land Disturbance	2/7/2022
MO-RA13248	Frisco Senior Village	Construction or Land Disturbance	2/7/2022
MO-RA13456	Empire District Electric Co.	Construction or Land Disturbance	2/7/2022
MO-RA14705	Bolivar Early Childhood Learning Center	Construction or Land Disturbance	2/7/2022

For this Revised TMDL, the Department assumes the general and non-MS4 stormwater permits described in Tables 11 and 12, as well as any future general or stormwater permitted activities, will be conducted in compliance with all permit conditions, including monitoring and discharge limitations. It is expected that compliance with these permits will be protective of the applicable designated uses within the watershed. For these reasons, general wastewater and stormwater permits are not expected to cause or contribute to the aquatic life impairment of Town Branch or Piper Creek. At any time, if the Department determines that the water quality of streams in the watershed is not being adequately protected, the Department may require the owner or operator of the permitted site to obtain a site-specific operating permit per 10 CSR 20-6.010(13)(C).

6.1.6 Illicit Straight Pipe Discharges

Illicit straight pipe discharges of domestic wastewater are also potential point sources of nutrients and oxygen consuming substances. These types of sewage discharges bypass treatment systems, such as a septic tank or a sanitary sewer, and instead discharge directly to a stream or an adjacent land area (Brown et al. 2004). Illicit straight pipe discharges are illegal and not authorized under the federal Clean Water Act. At present, there are no data about the presence or number of illicit straight pipe discharges in the Piper Creek watershed. For this reason, it is unknown to what significance straight pipe discharges contribute pollutant loads to Town Branch and Piper Creek. Due to the illegal nature of these discharges, any identified illicit straight pipe discharges must be eliminated. Illicit discharge detection and elimination is one of the six minimum control measures required by an MS4 permit. Therefore, such sources in areas serviced by regulated MS4s are expected to be detected and eliminated in accordance with existing permitted conditions.

6.2 Nonpoint Sources

Nonpoint source pollution refers to pollution coming from diffuse, non-permitted sources that typically cannot be identified as entering a water body at a single location and include all other categories of pollution not classified as being from a point source. Nonpoint sources are exempt from Department permit regulations per state rules at 10 CSR 20-6.010(1)(B)1. These sources involve stormwater runoff over land and are typically minor or negligible under low-flow conditions. However, sediment and organic material carried into streams during high precipitation events can accumulate in the receiving streambed. These accumulations can contribute to low quality benthic macroinvertebrate habitat and algae growth that may result in increased oxygen demand during low-flow conditions when water temperatures are warmer and flowing too slowly for adequate reaeration. Runoff from agricultural areas and non-MS4 permitted urban areas, onsite wastewater treatment systems, and areas with poor riparian corridor conditions are typical sources of nonpoint pollutants that contribute to water quality impairments.

6.2.1 Agricultural Runoff

Stormwater runoff and soil erosion from lands used for agricultural purposes (hay and pasture, and cropland) are sources of sediment and nutrient loading. Fertilizer is applied to agricultural lands as chemical forms of nitrogen and phosphorus and as animal manure. Application rates and timing vary by site depending upon a number of factors, including manure quality and soil fertility. Livestock that are not excluded from streams may deposit manure directly into waterways. Operations using nutrient management plans to guide fertilizer applications and employ best management practices to reduce soil erosion and exclude animals from streams will contribute smaller nutrient and sediment loads than those that do not.

Over 80 percent of soils in the Piper Creek watershed have moderate to high runoff potential and agricultural areas (cropland and pastureland) account for 58 percent of the watershed. Best management practices such as preventing livestock from entering streams, reducing fertilizer application, and managing erosion are needed to address the sediment and macroinvertebrate habitat impairments in Piper Creek.

6.2.2 Unregulated Urban Runoff

The primary source of urban runoff in the watershed is from the City of Bolivar. The majority of urban runoff drains to Town Branch upstream of the Bolivar Wastewater Treatment Facility. As mentioned previously, stormwater discharges from Bolivar are regulated by an MS4 permit. For this reason, there are minimal unregulated urban runoff contributions to Town Branch and Piper Creek. Unregulated urban runoff sources do not cause or contribute to the water quality impairments.

6.2.3 Onsite Wastewater Treatment Systems

Approximately 25 percent of homes in Missouri utilize onsite wastewater treatment systems, particularly in rural areas where public sewer systems may not be available (DHSS 2018). Onsite wastewater treatment systems treat domestic wastewater and disperse it on the property from where it is generated (i.e., a home septic system). When properly designed and maintained, such systems perform well and should not serve as a source of contamination to surface waters. However, onsite wastewater treatment systems can fail for a variety of reasons. When these systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration), there can be adverse effects to surface water quality (Horsley and Witten 1996). Failing onsite wastewater treatment systems can contribute nutrient loads and oxygen consuming substances to nearby streams under wet or dry weather conditions through surface runoff and groundwater flows. Onsite wastewater treatment systems may contribute pollutants to water bodies directly or as component of stormwater runoff.

The exact number of onsite wastewater treatment (septic) systems in the Piper Creek watershed is unknown. EPA's online input data server for STEPL provides estimates of septic system numbers and population per system by 12-digit HUC watersheds based on 1992 and 1998 data from the National Environmental Service Center (USEPA 2014b).[10] Estimates of septic system numbers for 12-digit HUC 102901070303 are presented in Table 14. The statewide estimated failure rates were estimated from a study by the Electric Power Research Institute (EPRI 2000). The study suggests that in some areas in Missouri, up to 50 percent of onsite wastewater treatment systems may be

[10] The National Environmental Services Center is located at West Virginia University and maintains a clearinghouse for information related to, among other things, onsite wastewater treatment systems. Available URL: www.nesc.wvu.edu/

failing. Although failing onsite wastewater treatment systems are potential sources of nutrient loading, the significance of such contributions to Town Branch and Piper Creek is unknown.

Table 14. STEPL Derived Estimates of Septic System Number in the Piper Creek Watershed

Population per System	Number of Systems	Potential Failure Rates
2	1,623	30 – 50%

6.2.4 Riparian Corridor Conditions

Riparian corridor conditions have a strong influence on instream water quality. Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in the detention, removal, and assimilation of pollutants in runoff. Therefore, a stream with good riparian cover is often better able to mitigate the impacts of high pollutant loads than a stream with poor or no riparian cover. Shade provided by riparian corridors is also important because it helps to keep water cooler and reduce temperature variation, especially during the critical low flows of July and August. Table 14 presents land cover calculations for the area within 100 feet of the impaired streams. Although 45 percent of the riparian corridor is forested, 37 percent is hay and pasture lands which are subject to high erosion and nutrient runoff.

Table 15. Land Cover within 100 feet of the Impaired Segment and Tributaries

Land Cover	Area (acres)	Percent (%)
Developed	241	12
Cultivated Crops	9	0.47
Hay and Pasture	734	37
Forest	890	45
Shrub and Herbaceous	72	4.0
Wetlands	34	1.7
Total	1,980	100

7. Numeric TMDL Targets and Modeling Approach

The pollutant targets in this revised TMDL have been established to reduce organic sediment from the Bolivar Wastewater Treatment Facility, and to reduce sediment transport from nonpoint sources, such that organic sediment and nutrients will be reduced and macroinvertebrate habitat will improve. The targets address violations of Missouri's general water quality criteria, and the warm water habitat (aquatic life) designated use will be restored. The targets include ammonia nitrogen, TN, TP, and BOD. Support for the selected targets are provided using a QUAL2K model. An additional TSS target is included in this TMDL to address excess sedimentation. The load duration curve approach was used to calculate the loading capacity for TSS.

7.1 Sediment and Nutrients

Sediment transported into streams from point sources and nonpoint sources contains nitrogen and phosphorus (nutrients/organic material), which requires oxygen for decomposition, promotes benthic algae growth, and impacts benthic macroinvertebrate communities. Although dissolved oxygen concentrations are not typically low in Town Branch or Piper Creek, morning to midday ranges fluctuate from around 6 mg/L to 14 mg/L (Table 6). As noted in Section 5, large fluctuations in dissolved oxygen concentrations are a product of daily fluctuations in respiration and photosynthesis from benthic algae. Substantial coverage of the stream bottom by algae limits available habitat for aquatic macroinvertebrates. Likewise, organic and fine eroded sediment on the

stream bottom can also be detrimental to macroinvertebrate habitat because it fills interstitial spaces in coarse sediment and can smother larvae. Reduction of organic sediment and nutrients will provide improved aquatic habitat in Piper Creek and Town Branch and promote attainment of the warm water habitat aquatic life designated use.

7.2 Total Suspended Solids

Total suspended solids are solids that are suspended (i.e., floating) in stream water or wastewater effluent and include both inorganic and organic sediments. Total suspended solids are comprised of both inorganic solids such as sand and silt, as well as decomposable organic solids such as sewage particulates. Point sources reduce or remove total suspended solids through filtration of effluent, while nonpoint sources reduce total suspended solids through control of sediment erosion using best management practices. Because phosphorus can adhere to soil carried in runoff, and organic sediment is a component of total suspended solids, reductions in total suspended solids are expected to result in additional reductions of nutrient and organic sediment loading that may contribute to excessive algae growth and harmful bottom deposits.

7.3 Biochemical Oxygen Demand

Biochemical oxygen demand is representative of both the quantity of organic material in effluent and the concentration of dissolved oxygen in the receiving stream. Biochemical oxygen demand is composed of carbonaceous biochemical oxygen demand (CBOD) (i.e., the amount of oxygen needed for the microbial utilization of carbon compounds) and nitrogenous biochemical oxygen demand (NBOD) (i.e., the amount of oxygen needed for the microbial oxidation of certain nitrogen compounds). NBOD is estimated directly from Total Kjeldahl Nitrogen (TKN), which is ammonia nitrogen (NH_4-N) plus organic nitrogen.

7.4 Ammonia as Nitrogen (NH_4-N)

Ammonia nitrogen can influence water quality in natural systems in two ways. The nitrification process in which ammonia nitrogen is reduced to nitrate (NO_3) consumes an estimated 4.2-4.6 grams of oxygen as O_2 per gram of ammonia as NH_4 (Cox 2003). High ammonia nitrogen concentrations in wastewater effluent exert a high oxygen demand (as NBOD) that can contribute to low dissolved oxygen in receiving streams. In addition to depleting oxygen, ammonia can be toxic to aquatic life and must not exceed the concentrations found in Tables B1 and B2 of Missouri's Water Quality Standards. Water quality targets for ammonia nitrogen must be protective of both possible pathways.

7.5 QUAL2K Modeling

QUAL2K is a steady state model based on the Streeter-Phelps equation that estimates the effects of point source biochemical oxygen demand from sewage effluent on receiving stream dissolved oxygen concentrations. QUAL2K simulates the link between dissolved oxygen and biochemical oxygen demand. The QUAL2K model calculates biochemical oxygen demand by using CBOD, organic nitrogen, and ammonia nitrogen data from the wastewater treatment facility's discharge monitoring report and produces estimates of in-stream dissolved oxygen concentrations.

Two QUAL2K models, a calibration model and a critical condition model, were developed to evaluate the potential for facility wasteload allocations to address the organic sediment and "unknown" impairments in Town Branch and Piper Creek. Data from the 2013 wasteload allocation study for the Bolivar Wastewater Treatment Facility were used to calibrate the model. The 2018

wasteload allocation study was not used due to numerous “no data” records for the 2018 study, and because 2018 was a documented drought year. The data and model assumptions are presented in Appendix A.

The QUAL2K critical condition model was used to determine wasteload allocations for the Bolivar Wastewater Treatment Facility that should result in reductions of nutrients, benthic algae, and the magnitude of eutrophication induced fluctuation of water chemistry (e.g., dissolved oxygen concentrations) downstream of the facility. Reducing organic sediment loading and benthic algae will improve aquatic habitat through reduction of harmful bottom deposits that prevent full maintenance of the beneficial use. Reduction in benthic algae will also reduce the magnitude of eutrophication induced fluctuations in dissolved oxygen concentrations. Minimizing the magnitude of eutrophication induced water chemistry changes will reduce aquatic ecosystem stress and the negative impact such chemical changes have on the natural biological community (MPCA 2008). Collectively, these reductions will address the organic sediment and “unknown” impairment of the biological community in Town Branch and Piper Creek.

When the wasteload allocations in Table 19 are applied to the Bolivar facility, DO concentrations greater than 5.0 mg/L are maintained downstream of the facility and the difference between morning and afternoon dissolved oxygen concentrations is minimized. This response in DO concentrations is indicative of a predicted reduction of benthic algae in the stream due to a reduction of nutrient loading (TN and TP) from the facility. The critical condition model also demonstrates a substantial reduction in nitrogen and phosphorous along the impaired segment compared to the data recorded in 2013. Graphical model outputs are provided in Appendix A.

7.6 Total Suspended Solids Load Duration Curve

The load duration curve approach was used to calculate the allowable loading of total suspended solids into Town Branch and Piper Creek. The load duration approach provides a visual representation of stream flow conditions and the pollutant loading that will attain surface water quality targets during those flow conditions. When observed data from the impaired water body is available, the load duration curve approach is also useful in identifying and differentiating between storm-driven and steady-input sources, which can then inform appropriate restoration actions. To develop the total suspended solids load duration curve for Town Branch and Piper Creek, a flow duration curve was developed using a synthetic flow derived from the average daily flow data collected from multiple USGS stream gages in the EDU where Town Branch and Piper Creek are located. For this TMDL, the targeted pollutant loading for total suspended solids is based on the 25th percentile concentration of all USGS total suspended solids data available from Missouri in the EDU in which Town Branch and Piper Creek are located. The concentration target calculated using this approach is 5 mg/L. Additional discussion about the methods used in the modeling and development of the TSS load duration curve for Town Branch and Piper Creek is presented in Appendix B.

8. Calculating Loading Capacity

A TMDL calculates the loading capacity of a water body and allocates that load among the various pollutant sources in the watershed. The loading capacity is the maximum pollutant load that a water body can assimilate and still meet water quality standards. The TMDL is equal to the sum of the wasteload allocations, load allocations, and the margin of safety:

$$TMDL = LC = \Sigma WLA + \Sigma LA + MOS$$

where, LC is the loading capacity, ΣWLA is the sum of the wasteload allocations, ΣLA is the sum of the load allocations, and MOS is the margin of safety.

The following formula is used to convert pollutant concentrations to pounds/day:

(flow in ft^3/sec)(maximum allowable pollutant concentration in mg/L)(5.395*)= pounds/day
*5.395 is the conversion factor used to obtain units of pounds/day.

The pollutant loading capacities for BOD, nutrients, and ammonia as nitrogen are calculated at critical and typical (90 percent flow exceedance) low-flow conditions, and are equal to the sum of the nonpoint source load allocation and the sum of wasteload allocations to the Bolivar Wastewater Treatment Facility. An implicit margin of safety is used for all TMDL calculations as described in Section 11. The pollutant loading capacity and allocations for the impaired segments are presented in Tables 16 and 17. The loading capacity for TSS is calculated using a load duration curve (Figure 12), and allocations at various flows are presented in Table 18. Additional discussion regarding specific allocations of pollutant loading capacities and margin of safety is provided in Sections 9, 10, and 11.

Table 16. Low Flow TMDL for Town Branch and Piper Creek

Pollutant	Loading Capacity (lbs/day)	∑Wasteload Allocation (lbs/day)	∑Load Allocation (lbs/day)
BOD_5	106.55	106.55	0
TP	10.67	10.66	0.012
TN	292.13	291.99	0.139
NH_3-N	14.92	14.92	0

Table 17. Typical Low Flow (90% Flow Exceedance) TMDL for Town Branch and Piper Creek

Pollutant	Loading Capacity (lbs/day)	∑Wasteload Allocation (lbs/day)	∑Load Allocation (lbs/day)
BOD_5	106.55	106.55	0
TP	11.58	11.12	0.462
TN	303.05	297.50	5.550
NH_3-N	14.92	14.92	0

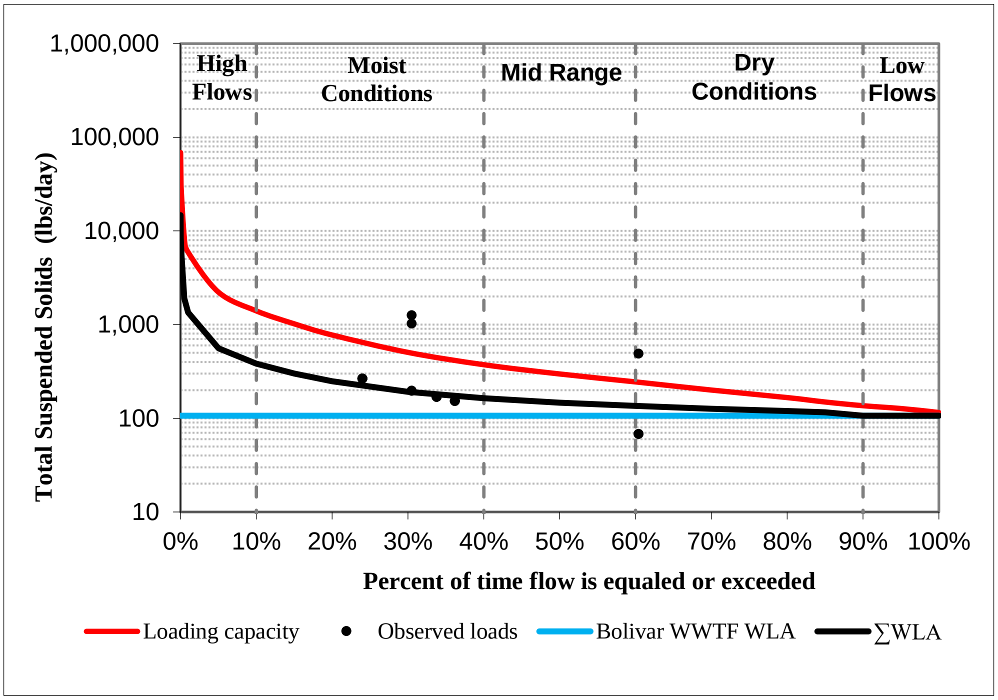

Figure 12. Total Suspended Solids Load Duration Curve

Table 18. Total Suspended Solids TMDL and Allocations at Various Flows

Percent of time flow equaled or exceeded	Flow (cfs)	Loading Capacity (lbs/day)	∑Wasteload Allocation (lbs/day)	∑Load Allocation (lbs/day)
95	4.7	127	111	16
75	6.7	181	122	58
50	11.0	297	147	150
25	22.5	607	213	394
5	82.4	2,223	557	1,665

9. Wasteload Allocation (Allowable Point Source Load)

The wasteload allocation is the allowable amount of the loading capacity assigned to existing or future point sources. This section discusses the rationale and approach for assigning wasteload allocations to point sources in the Piper Creek watershed as well as considerations given for future sources. Typically, point source permit limits for a given pollutant are the most stringent of either technology-based effluent limits or water quality-based effluent limits. Technology-based effluent limits are based upon the expected capability of a treatment method to reduce the pollutant to a certain concentration. Water quality-based effluent limits represent the most stringent concentration of a pollutant that a receiving stream can assimilate without violating applicable water quality standards at a specific location. Final effluent limits or other permit conditions must be consistent with the assumptions and requirements of TMDL wasteload allocations per 40 CFR 122.44(d)(1)(vii)(B). Mixing zones and zones of initial dilution are not allowed in regulation for streams with 7Q10 low flows of less than 0.1 cubic feet per second (cfs) [10 CSR 20-7.031(5)(A)4.B.(I)]. The Piper Creek 7Q10 low flow, as estimated at the Bolivar Wastewater

Treatment Facility,[11] is 0.0077 cfs. Therefore, in order to ensure attainment of applicable water quality standards in Town Branch and Piper Creek, all water quality targets must be met at end of pipe. The wasteload allocations in this TMDL report do not authorize any facility to discharge pollutants at concentrations that exceed water quality standards.

9.1 Municipal and Domestic Wastewater Discharges

Because biological assessment studies found only minimal improvement in the benthic macroinvertebrate community in 2015-2016 compared to 2003-2004, the evidence suggests that consistent and sustained reductions in effluent nutrients and TSS from the Bolivar Wastewater Treatment Facility are needed to address the organic sediment impairment and improve in-stream habitat for macroinvertebrates.

In order to prevent degradation to in-stream habitat, a concentration of 1.0 mg/L ammonia nitrogen is allocated to the Bolivar Wastewater Treatment Facility. This concentration is also required to meet the Missouri chronic criteria during low flow conditions. A total nitrogen concentration of 14 mg/L, to include 1.0 mg/L of ammonia nitrogen and up to 12 mg/L of nitrate/nitrite is supported by the QUAL2K models. The models show that nitrate/nitrate exerts only minimal oxygen demand, and at 12 mg/L is not likely to be detrimental to aquatic life.

The total phosphorous wasteload allocation for the Bolivar Wastewater Treatment Facility has been established based on a technology limit of 0.5 mg/L as recommended by Department engineering staff. This technology-based limit was confirmed by the QUAL2K model to achieve the minimum dissolved oxygen criterion and is expected to minimize the fluctuation between morning and afternoon dissolved oxygen concentrations.

As discussed in Section 6.1.1, the Bolivar Wastewater Treatment Facility is the only domestic wastewater discharger that influences water quality in Town Branch and Piper Creek during critical low flow conditions, and is the predominant source of pollutants during all flow regimes. The other wastewater treatment facilities in the Piper Creek watershed do not contribute to the stream impairments. Therefore, the wasteload allocations for these other facilities is set at existing permit limits and conditions (Table 19). The wasteload allocations for the Bolivar Wastewater Treatment Facility are supported by QUAL2K modeling, and are expected to achieve water quality standards and improve in-stream habitat through reduction of dissolved oxygen fluctuations and eutrophication. The QUAL2K wasteload allocation model demonstrates that when the wasteload allocations in Table 19 are applied to the Bolivar Wastewater Treatment Facility, the difference between morning and afternoon dissolved oxygen concentrations is reduced, indicating less algal growth and respiration. Wasteload allocations to the Bolivar Wastewater Treatment Facility are applicable at all flows. In addition to authorized discharges from municipal wastewater treatment facilities, areas serviced by sanitary sewer systems risk nutrient contributions from accidental overflows. As mentioned in Section 6.1.1 of this document, sanitary sewer overflows are unpermitted discharges and not authorized under the federal Clean Water Act. For this reason, sanitary sewer overflows are assigned a wasteload allocation of zero.

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[11] Per StreamStats: Streamflow Statistics and Spatial Analysis Tools for Water-Resources Applications https://streamstats.usgs.gov/ss/

Table 19. Wasteload Allocations for Domestic Wastewater Dischargers

Effluent Parameter	Design Flow (MGD)	Existing Permit Limit		WLA at Design Flow		Percent Reduction
		Concentration (mg/L)	Load (lbs/day)	Concentration (mg/L)	Load (lbs/day)	
Bolivar WWTF (MO-0022373)						
BOD_5	2.55	Monthly Average = 30	639	5.0	106.6	83%
TP	2.55	No Existing Limit	No data	0.5	10.6	No data
TN	2.55	No Existing Limit	No data	13.7	292.0	No data
NH_3-N	2.55	Monthly Average = 1.4	30	0.7	14.9	50%
TSS	2.55	Monthly Average = 27	575	5.0	106.6	81%
DO (minimum)	2.55	No Existing Limit	N/A	> 6.0	N/A	N/A
Other Permitted Domestic Wastewater Dischargers						
Same as above	0.089	N/A		Existing permit limits and conditions		N/A
Sanitary Sewer Overflows						
Illegal discharge				0		N/A

For point source reductions to consistently achieve the specified loading targets, upgrades to the Bolivar Wastewater Treatment Facility, such as biological or enhanced nutrient removal, may be necessary.

9.2 Site-Specific Permitted Industrial and Non-Domestic Wastewater Facilities

There are no site-specific permitted industrial and non-domestic wastewater facilities in the Piper Creek watershed. Therefore, such sources are not assigned a portion of the calculated loading capacity.

9.3 CAFOs

There are no CAFOs in the Piper Creek watershed, thus CAFOs are not assigned a portion of the calculated loading capacity.

9.4 MS4 Permits

As mentioned in Section 6.1.4, urban runoff is a potential contributor of sediment and nutrient loading to streams. During periods of low precipitation and critical low flows, pollutants may be transported into storm sewers from lawn irrigation and car washing on residential properties. The Bolivar MS4 has been assigned wasteload allocations as presented in Tables 20 and 21 to address nutrient loading in Town Branch upstream of the Bolivar Wastewater Treatment Facility. The Bolivar MS4 wasteload allocations for nutrients represent the RTAG benchmarks described in Section 5, Table 8. Bolivar MS4 wasteload allocations for TSS were derived for various flows using the load duration curve approach, and are presented in Table 22. Total suspended solids wasteload allocations are based on the proportion of municipal area in the watershed (21.3 percent) and available loading after allocations to the Bolivar Wastewater Treatment Facility and the Bolivar MS4. Upon approval of this TMDL, the City of Bolivar will be required by their permit to develop

an Assumptions and Requirements Attainment Plan for the MS4 to incorporate best management practices (BMPs) consistent with the goals of this TMDL. BMPs that address the pollutants of concern addressed by this TMDL, which are implemented as part of MS4 permit requirements to reduce stormwater pollutant loading to the maximum extent practicable, will be consistent with the assumptions and requirements of this TMDL. Reduction of pollutant loading during stormwater discharges is expected to result in net pollutant reductions during critical low flow conditions. Required MS4 control measures, such as illicit discharge elimination, and public education and outreach, may be used to address additional non-stormwater generated pollutant loading that may occur during low flow conditions. Implementation of such measures is consistent with the assumptions and requirements of this TMDL

The MoDOT TS4 receives runoff primarily from highways, accounts for only 1.7 percent of the total watershed area, and is not expected to contribute significant loads of sediment, nutrients, or oxygen consuming substances to Town Branch or Piper Creek. Existing permit conditions and continued implementation of required stormwater management programs are expected to result in *de minimis* pollutant loading that will not exceed the total wasteload allocation. For this reason, no specific portion of the loading capacity is allocated to the MoDOT TS4.

Table 20. Critical Low Flow (7Q10) MS4 Wasteload Allocations

Effluent Parameter	WLA	
	Concentration (mg/L)	Load (lbs/day)
TP	0.075	0.003
TN	0.900	0.037

Table 21. Typical Low Flow (90% Exceedance) MS4 Wasteload Allocations

Effluent Parameter	WLA	
	Concentration (mg/L)	Load (lbs/day)
TP	0.075	0.462
TN	0.9	5.550

Table 22. Total Suspended Solids Wasteload Allocation for the Bolivar MS4 at Various Flows

Percent of time flow equaled or exceeded	Flow (cfs)	Loading Capacity (lbs/day)	MS4 Wasteload Allocation (lbs/day)
95	4.7	127	4
75	6.7	181	16
50	11.0	297	41
25	22.5	607	107
5	82.4	2,223	451

9.5 General Wastewater and Non-MS4 Stormwater Permits

Activities permitted through general or stormwater permits are not expected to contribute significant pollutant loads to surface waters. It is expected that compliance with these types of permits will be protective of the warm water habitat use designated to Town Branch and Piper Creek. For this reason, these types of facilities are not assigned a specified portion of the calculated loading capacity and wasteload allocations are set at existing permit limits and conditions, which

are assumed to result in pollutant loading at *de minimis* concentrations that will not exceed the total wasteload allocation.

9.6 Illicit Straight Pipe Discharges

Illicit straight pipe discharges are illegal and are not permitted under the federal Clean Water Act. For this reason, illicit straight pipe discharges are assigned a wasteload allocation of zero. Any existing sources of this type must be eliminated.

9.7 Considerations for Future Point Sources

For this TMDL, no specific portion of the loading capacity is allocated to a reserve capacity. However, the wasteload allocations presented in this TMDL report do not preclude the establishment of future point sources in the watershed. Any future point sources should be evaluated against the TMDL, the range of flows with which any additional loading will affect, and any additional requirements associated with antidegradation. Per federal regulations at 40 CFR 122.4(a), no permit may be issued when the conditions of the permit do not provide for compliance with the applicable requirements of the federal Clean Water Act, or regulations promulgated under the federal Clean Water Act. Additionally, 40 CFR 122.4(i) states no permit may be issued to a new source or new discharger if the discharge from its construction or operation will cause or contribute to violation of water quality standards. Facility types not currently existing in the watershed and not allocated a portion of the loading capacity may be permitted as no discharge facilities as long as permit conditions for land application or other controls maintain potential loading at *de minimis* concentrations. Future general (MO-G) and stormwater (MO-R) permitted activities that operate in full compliance with permit conditions are not expected to contribute pollutant loads above *de minimis* levels and will not result in loading that exceeds the sum of the TMDL wasteload allocations. Decommissioning of onsite wastewater treatment systems and home connection to a sewerage system for wastewater treatment will result in net pollutant reductions that are consistent with the goals of this TMDL. Wasteload allocations calculated for the Bolivar Wastewater Treatment Facility are based on design flow instead of actual flow, and thus account for future discharge increases. Wasteload allocations between point sources may also be appropriately shifted between individual point sources where pollutant loading has shifted as long as the sum of the wasteload allocations is unchanged. In some instances a potential source may be re-categorized from a nonpoint source to a point source (e.g., newly designated MS4s or other permitted stormwater). If such a source’s magnitude, character, and location remain unchanged, then the appropriate portion of the load allocation may be assigned as a wasteload allocation.

10. Load Allocation (Nonpoint Source Load)

The load allocation is the amount of the pollutant load that is assigned to existing and future nonpoint sources, as well as natural background contributions (40 CFR 130.2(g)). Best management practices (BMPs) that reduce erosion and nutrient transport are recommended to reduce pollutant loading from the agricultural areas to Town Branch and Piper Creek.

The nonpoint source load allocations for nitrogen and phosphorus in Tables 16 and 17 (Section 8) were derived using 7Q10 flows estimated by the USGS Stream Stats tool, the flow corresponding to the 90 percent flow exceedance from the synthetic flow duration curve, and the RTAG benchmarks in Table 8. Load allocations for TSS are calculated as the remainder of the loading capacity after allocations to the wasteload allocation and are presented in Table 18. The load allocations in pounds per year are the RTAG benchmark concentrations multiplied by the flows in cubic feet per second

and a conversion factor of 5.395. Although loading capacity and load allocations are presented only for low flow conditions, it is expected that nonpoint source pollutant reductions in the watershed will target the RTAG benchmarks during all flow conditions. Load allocations for TSS are the remainder of the TSS loading capacity after allocations to the Bolivar Wastewater Treatment Facility and the Bolivar MS4.

11. Margin of Safety

A margin of safety is required in the TMDL calculation to account for uncertainties in scientific and technical understanding of water quality in natural systems (CWA Section 303(d)(l)(C) and 40 C.F.R. 130.7(c)(l)). The margin of safety is intended to account for such uncertainties in a conservative manner. Based on EPA guidance, the margin of safety can be achieved through two approaches:

- Explicit - Reserve a portion of the loading capacity as a separate term in the TMDL.
- Implicit - Incorporate the margin of safety as part of the critical conditions for the wasteload allocation and the load allocation calculations by making conservative assumptions in the analysis.

For this TMDL an implicit margin of safety was used. The margin of safety was incorporated into the development of this TMDL by making conservative assumptions in the analysis as follows:

- Critical low flow values are used as inputs for QUAL2K modelling.
- Wasteload allocations to the Bolivar MS4 and load allocations to nonpoint sources are based on RTAG benchmark concentrations.
- Total suspended solids targets are based on the 25th percentile concentration of all USGS total suspended solids data available from Missouri in the EDU in which Town Branch and Piper Creek are located. Additionally, because phosphorus can adhere to soil carried in runoff and organic sediment is a component of total suspended solids, reductions in total suspended solids are expected to result in additional nutrient and organic loading reductions.

12. Seasonal Variation

Federal regulations at 40 CFR 130.7(c)(1) require that TMDLs take into consideration seasonal variation in applicable standards. This TMDL considered seasonal variation by assuming that the Bolivar Wastewater Treatment Facility accounts for the majority of the flow in Town Branch and Piper Creek during critical low flow conditions. The Missouri Water Quality Standards account for seasonal variation by establishing ammonia as nitrogen criteria based on pH and temperature such that the criteria are more stringent when water temperatures are higher, such as during summer critical low flow conditions. Application of targets derived for critical low flows maintains protection during all seasons. For TSS, the load duration curve developed for this TMDL represents streamflow under all conditions as it was developed using numerous years of flow data collected during all seasons. For this reason, the TSS targets and allocations found in this TMDL report will be protective of applicable general criteria during all seasons and under all flow conditions.

13. Monitoring Plans

The Department often schedules and carries out post-TMDL monitoring within a reasonable timeframe following completion of permit compliance schedules, facility upgrades, or the implementation of watershed BMPs. Biological Assessment studies conducted in 2015-2016 showed no change in benthic macroinvertebrate community composition compared to studies conducted in 2003-2004. Wasteload allocation studies were conducted for the Bolivar Wastewater Treatment Facility in 2013 and 2018, and showed no significant difference in nitrogen and phosphorus concentrations in Town Branch or Piper Creek. The Department will defer further monitoring until such time nutrient removal and further reductions of BOD and TSS are reported for the Bolivar Wastewater Treatment Facility.

The Department will also routinely examine any available quality-assured water quality data collected from Piper Creek and Town Branch by other local, state, and federal entities in order to assess the effectiveness of TMDL implementation. In addition, certain quality-assured data collected by universities, municipalities, private companies, and volunteer groups may potentially be considered for monitoring water quality following TMDL implementation.

14. Reasonable Assurance

Section 303(d)(1)(C) of the federal Clean Water Act requires that TMDLs be established at a level necessary to implement applicable water quality standards. As part of the TMDL process, consideration must be given to the assurances that point and nonpoint source allocations will be achieved and water quality standards attained. Where TMDLs are developed for waters impaired by point sources only, reasonable assurance is provided through the NPDES permitting program. State operating permits requiring effluent and instream monitoring be reported to the Department should provide reasonable assurance that instream water quality standards will be met. The Department regulates point source discharges from the Bolivar Wastewater Treatment Facility through Missouri State Operating Permit No. MO-0022373 and from the Bolivar Small MS4 through MO-R040113.

Where a TMDL is developed for waters impaired by both point and nonpoint sources, point source wasteload allocations must be stringent enough so that in conjunction with the water body's other loadings (i.e., nonpoint sources) water quality standards are met. Reasonable assurance that nonpoint sources will meet their allocated amount is dependent upon the availability and implementation of nonpoint source pollutant reduction plans, controls, or BMPs within the watershed. If BMPs or other nonpoint source pollution controls allow for more stringent load allocations, then wasteload allocations can be less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs (40 CFR 130.2(i)). When a demonstration of nonpoint source reasonable assurance is developed for an impaired water body, additional pollutant allocations for point sources may be allowed provided water quality standards are still attained. If a demonstration of nonpoint source reasonable assurance does not exist, or it is determined that nonpoint source pollutant reduction plans, controls, or BMPs are not feasible, durable, or will not result in the required load reductions, then allocation of greater pollutant loading to point sources cannot occur. This TMDL assumes discharge from the Bolivar Wastewater Treatment Facility is the primary source of flow in Town Branch and Piper Creek during critical low-flow conditions. Therefore, this TMDL does not include wasteload allocations that are less stringent than the water quality targets determined to attain water quality standards.

A variety of grants and loans may be available to assist watershed stakeholders with developing and implementing watershed based plans, controls, and practices to meet the required wasteload and load allocations in the TMDL and demonstrate reasonable assurance. Additionally, cost-share opportunities for implementation of agricultural BMPs are also available. Examples of nonpoint source reduction practices implemented in the Piper Creek watershed between 2016 and 2019 are presented in Table 23. These practices reduce nutrient transport into streams by reducing overland runoff and excluding livestock from streams.

Additional information regarding potential funding sources, cost-share opportunities, and implementation actions addressing pollutant sources in the Piper Creek watershed is provided in the supplemental TMDL Implementation Strategies document available online at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

Table 23. Nonpoint Source Reduction Practices Implemented in the Piper Creek 12-digit HUC

Year	Practice	Sediment and Nutrient Reduction Area (Acres)
2016	Nutrient Management	179
2018	Nutrient Management	44.5
2019	Nutrient Management	44.5
	Stream Protection	26.9
	Livestock Exclusion	11.7
	Total	306.6

15. Public Participation

EPA regulations at 40 CFR 130.7 require that TMDLs be subject to public review. An initial 45-day public notice period for this revised TMDL was held from September 11 through October 26, 2020. No comments were received during that period. As a result of post-submittal comments by EPA, revisions were made to the underlying model used to calculate the TMDL. For this reason a second 45-day public comment period was held from February 4 through March 21, 2022. Groups that directly received notice of the public comment period for this TMDL include, but are not limited to:

- Missouri Clean Water Commission;
- Missouri Water Protection Forum;
- Missouri Department of Conservation;
- Polk County soil and water conservation district;
- Polk County commission;
- Southwest Missouri Council of Governments;
- University of Missouri Extension;
- Missouri Coalition for the Environment;
- Stream Teams United;
- Stream Team volunteers living in or near the watershed;
- Affected permitted entities; and

- Missouri state legislators representing areas within the watershed.

In addition to those groups contacted directly about the public notice, the Department posted this revised TMDL and an implementation strategies document online at dnr.mo.gov/water/what-were-doing/water-planning/quality-standards-impaired-waters-total-maximum-daily-loads/tmdls.

The Department also maintains an email distribution list for notifying subscribers of significant TMDL updates or activities, including public notices and comment periods. Those interested in subscribing to TMDL updates can submit their email address using the online form available at public.govdelivery.com/accounts/MODNR/subscriber/new?topic_id=MODNR_177.

16. Administrative Record and Supporting Documentation

The Department has an administrative record on file for the revised Piper Creek TMDL. The record contains any plans, studies, data, and calculations on which the TMDL is based. It additionally includes the public notice announcement, any public comments received, the Department's responses to those comments and files associated with the development of this revised TMDL and the original 2010 TMDL. This information is available upon request to the Department at dnr.mo.gov/open-records-sunshine-law-requests.

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Appendix A
Support for QUAL2K Model Assumptions

Calibration Model

The Revised QUAL2K model was calibrated to Department data recorded on July 9, 2013, as presented in Table A-1. Data recorded at Sample Point 1 were input for the QUAL2K Headwater values, and the recorded flow of 0.953 cfs (0.0270 cubic meters per second) was used. Point Source inputs for the Bolivar Wastewater Treatment Facility and the Piper Creek inflow are noted in bold type in Table A-1.

Table A-1. Data Used for the 2019 Revised QUAL2K Calibration Model*

Sample Point	Time	DO mg/L	pH	Specific Cond. µmhos	Temp. °C	BODult mg/L	CBODf mg/L	NH_3 mg/L	Nitrate/ Nitrite mg/L	Organic N mg/L	TP mg/L
1	6:05	7.38	8.1	464	20.9	ND	ND	0.057	2.12	0.333	0.019
1	11:55	11.04	8.7	449	23.8	2.26	1.75	0.056	2.08	0.224	0.022
Outfall		**4.8+/-1.5**	**7.9**	**706 +/-3**	**26 +/- 0.7**	**9.76**	**7.57**	**0.42**	**24.2**	**0.84**	**4.42**
2	6:25	6.61	8.0	569	22.6	ND	ND	0.15	11.1	0.53	1.89
2	11:35	9.71	8.3	598	24.8	3.43	ND	0.12	13.9	ND	2.42
3	6:20	5.76	6.9	585	22.3	ND	ND	0.11	8.85	0.37	1.59
3	12:25	10.72	6.3	568	26.7	ND	ND	0.091	7.45	0.639	1.27
Piper Creek		**7.0+/-3**	**6.6**	**577 +/-8**	**27.0**	**ND**	**2.66**	**0.101**	**8.15**	**0.050**	**1.43**
4	5:45	6.09	6.9	575	22.3	ND	ND	0.11	6.65	0.65	0.96
4	11:40	11.17	6.3	562	29.0	ND	ND	0.11	6.95	0.12	1.04

* ND = no data

Wasteload Allocation Model

As discussed previously, Town Branch and Piper Creek are not impaired for low DO. Morning DO data were collected upstream of the Bolivar WWTF in 2015, 2016, and 2018. The minimum morning DO concentration recorded during those sampling events is 6.6 mg/L. The calibration model Headwater diel difference is 3.7 mg/L. The WLA model Headwater DO has been changed to 6.6 mg/L in the morning and 10.3 mg/L in the afternoon (from 7.38 mg/L and 11.04 mg/L). In addition, the Headwater morning temperature has been raised to the temperature corresponding to the minimum DO concentration (22.6°C) and the Headwater afternoon temperature was raised to the maximum in the Town Branch dataset (24.2°C).The headwater and point source values input into the wasteload allocation model are presented in Table A-2.

Table A-2. Headwater and Point Source Inputs Into the Wasteload Allocation Model

Sample Point	Time	DO mg/L	pH	Specific Cond. µmhos	Temp. °C	CBODf mg/L	NH_3 mg/L	Nitrate/ Nitrite mg/L	Organic N mg/L	TP mg/L
Headwater		6.6	8.1	464	22.6	1.75	0.057	2.12	0.333	0.019
		10.3	8.7	449	24.20	1.75	0.056	2.08	0.224	0.022
Outfall		**6.0**	**7.9**	**706 +/-3**	**26 +/- 0.7**	**10.00**	**0.7**	**12.5**	**0.50**	**0.5**
Piper Creek		**7.0+/-3**	**6.6**	**577 +/-8**	**27.0**	**2.66**	**0.05**	**1.20**	**1.84**	**1.43**

The QUAL2K critical condition model demonstrates that when the wasteload allocations in Table 19 of the TMDL are applied to the Bolivar facility, dissolved oxygen concentrations greater than 5.0 mg/L are maintained downstream of the facility and the difference between morning and afternoon dissolved oxygen concentrations is reduced. This response in dissolved oxygen concentrations is indicative of a predicted reduction of benthic algae in the stream due to a reduction of nutrient loading (TN and TP) from the facility. The critical condition model also demonstrates a substantial reduction in nitrogen and phosphorous along the impaired segment compared to the data recorded in 2013. The reduction in daily fluctuations of dissolved oxygen instream will result in reduction of dissolved oxygen induced ecosystem stress and related negative impacts on the macroinvertebrate community. Model outputs of dissolved oxygen calibration to existing conditions are presented in Figure A-1. Model outputs of predicted dissolved oxygen concentrations during critical flows after application of stated wasteload allocations are presented in Figure A-2 and demonstrate in the expected reduction in daily dissolved oxygen fluctuations.

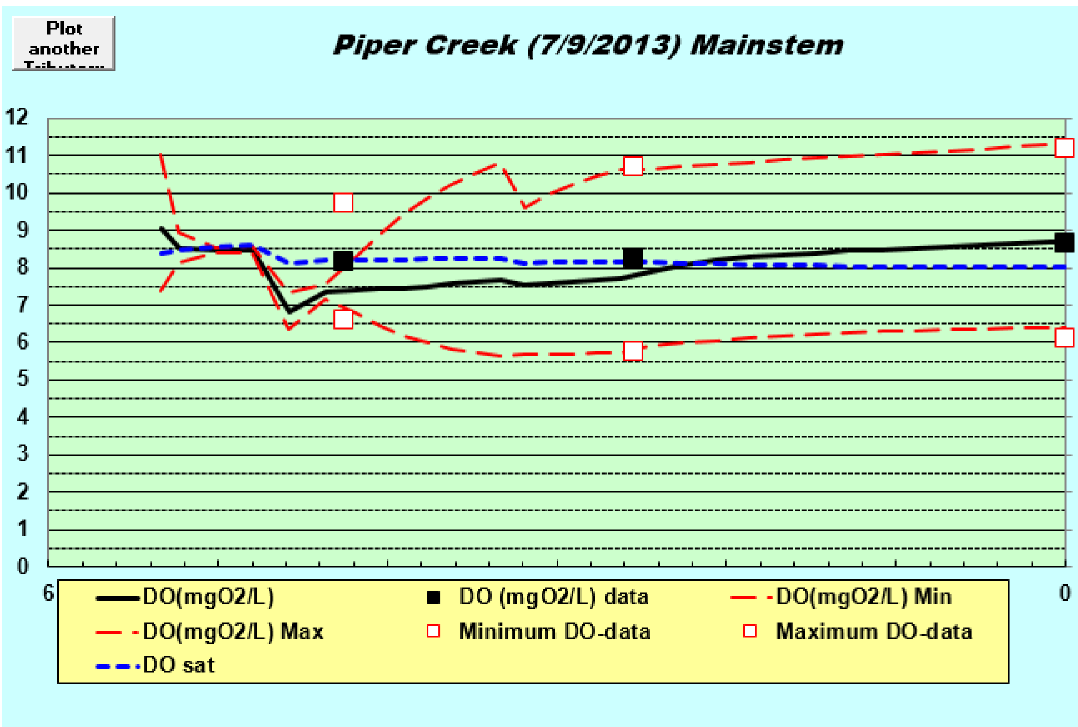

Figure A-1. QUAL2K Calibration Model – Dissolved Oxygen

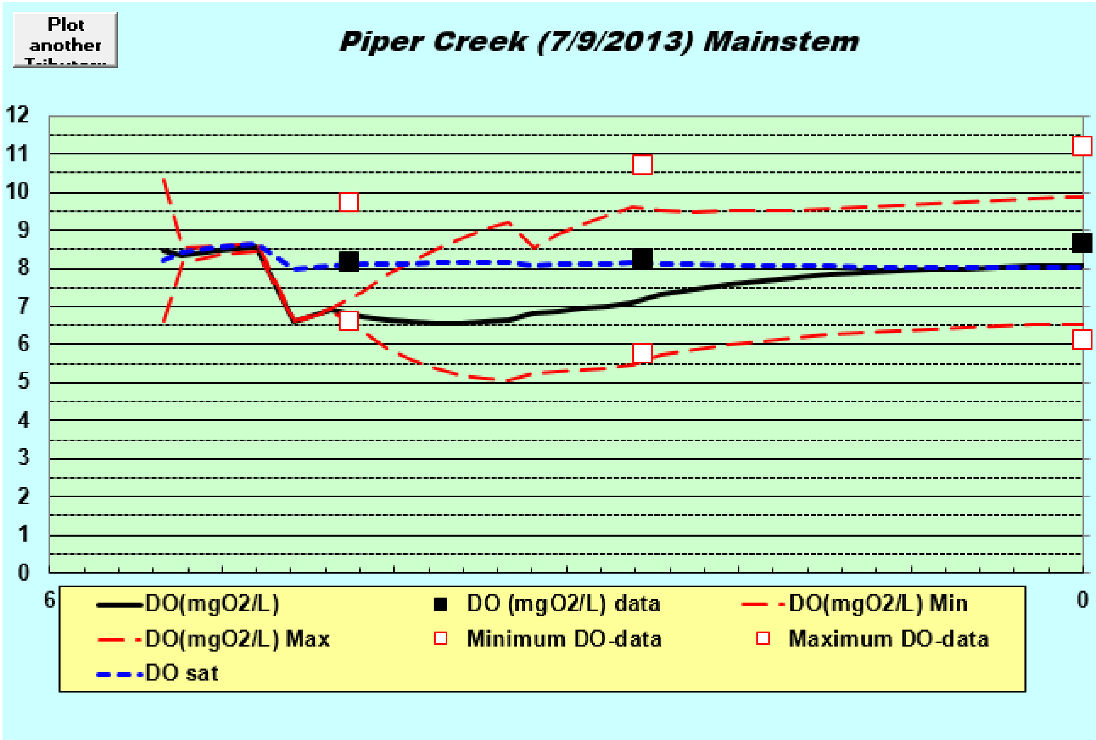

Figure A-2. QUAL2K Critical Condition Model – Dissolved Oxygen

Appendix B

TSS Load Duration Curve Development

Overview

The load duration curve approach was used to develop the TSS TMDL for Town Branch and Piper Creek. The load duration curve method allows for characterizing water quality concentrations at different flow regimes and estimating the load allocations and wasteload allocations for the impaired segment. This method also provides a visual display of the relationship between stream flow and loading capacity. Using the duration curve framework, allowable loadings are easily presented.

Methodology

The load duration curve method requires a long-term time series of daily flows and a numeric water quality target (typically the applicable numeric criterion or a surrogate when addressing general criteria). When available, pollutant data from the impaired segment is used to provide estimates of observed loads (based on flow estimates for the same date) and are plotted along with the load duration curve to assess when the water quality target may have been exceeded. Such information is useful for determining appropriate BMP to reduce pollutant loading.

The average daily flow data from a gage or multiple gages that are representative of the impaired reach are used to develop a load duration curve. The flow record should be of sufficient length to be able to calculate percentiles of flow. If a flow record for an impaired stream is not available, then flow data collected from a gage in a representative watershed may be used or a synthetic flow record from several gages can be developed. For Town Branch and Piper Creek, a synthetic flow record was developed using the log discharge per square mile of USGS gages from streams within the same EDU and 8-digit HUC as Town Branch and Piper Creek. Four gages with sufficient flow records were used to develop a synthetic flow (Table B-1) for this TMDL. Nash-Sutcliffe statistics were calculated for each gage flow record used to develop the synthetic flow in order to determine if the relationship is valid for each record. The Nash-Sutcliffe statistic evaluates the efficiency of a predicted (modeled) flow dataset (Nash and Sutcliffe 1970). An efficiency of 1 (100 percent) describes a perfect match, while values less than zero indicate a poor fit of modeled and observed datasets (USGS 2010). This relationship must be valid in order to use the synthetic flow methodology. Model estimates are considered satisfactory if Nash-Sutcliffe statistics are greater than 50 percent (USGS 2013). The mean Nash-Sutcliffe statistic for the Town Branch and Piper Creek synthetic flow was 89 percent.

Figure B-1 presents the synthesized flow duration curve developed for the EDU. Figure B-2 is the estimated flow for Town Branch and Piper Creek based on the area corrected synthesized flow and point source design flow discharges added. The estimated flows for Town Branch and Piper Creek, in units of cubic feet per second, were multiplied by the concentration target of 5 mg/L and a conversion factor of 5.394 in order to generate the allowable TSS load in units of lbs/day.[12] A reference approach was used to select the target concentration, which was derived from the 25th percentile of all TSS data in the EDU, and provides an implicit margin of safety. Table B-2 presents available TSS data from Town Branch and Piper Creek plotted along the load duration to illustrate conditions when excessive sediment loading may be occurring. Table B-3 presents all EDU TSS

[12] $Load\ \left(\frac{\text{lbs}}{\text{day}}\right) = \left[Target\left(\frac{\text{mg}}{\text{100ml}}\right)\right] * \left[Flow\ \left(\frac{feet^3}{s}\right)\right] * [Conversion\ Factor]$

data used to develop the loading target. The wasteload allocation for the Bolivar Wastewater Treatment facility is based on the facility's design flow and the concentration target of 6 mg/L as discussed in Section 9.1. Wasteload allocations to the Bolivar MS4 are based on the proportion of municipal area in the watershed and vary with flow (Table B-3). No TSS loading was allocated to the MS4 during low flow conditions. Allocations to nonpoint sources are the remainder of the loading capacity after allocations to the Bolivar Wastewater Treatment Facility and MS4. Nonpoint sources are not expected to contribute pollutant loading during critical low flow conditions, therefore load allocations to nonpoint sources at low flows will likely provide an additional margin of safety.

Table B-1. Stream gages used to develop synthetic flow for Town Branch and Piper Creek [13]

USGS Gage	Station Number	Drainage Area (mi^2)	Period of Data	Nash-Sutcliff (%)
Pearson Creek near Springfield, MO	07050690	21	8/1999-8/2019	98
Wilson Creek at Springfield, MO	07052000	17.8	10/1999-7/2019	71
Little Niangua River near Macks Creek, MO	06925250	125	5/2007-8/2019	97
Lindley Creek near Polk, MO	06921200	112	10/1999-8/2019	91
			Mean:	89

Table B-2. Available Total Suspended Solids data from Town Branch and Piper Creek (September 2015-August 2018)

Dates	Site Code	Site Name	Total Suspended Solids (mg/L)
9/21/2015 3/15/2016 8/22/2018 8/23/2018	3822/0.7	Town Br. 0.2 mi DS of 435th Rd.	5.0
9/22/2015	3822/0.9	Town Br. at 435th Rd.	5.0
8/22/2018 8/23/2018	3822/1.3	Town Br. @ Hwy 32	5.0
9/21/2015 3/15/2016 8/22/2018 8/23/2018	1444/3.2	Piper Cr. 3.1 mi.bl. Bolivar WWTP	5.0
3/15/2016 8/22/2018 8/23/2018	1444/4.8	Piper Cr. 1.5 mi.bl. Bolivar WWTP	5.0
8/22/2018	1444/5.3/1.2	Piper Cr. at 435th Rd.	5.0
9/21/2015 3/15/2016	1444/5.4	Piper Creek, 0.1 mi above entrance of Town Br	5.0

[13] Flow data that were in provisional status at the time of this report were not used

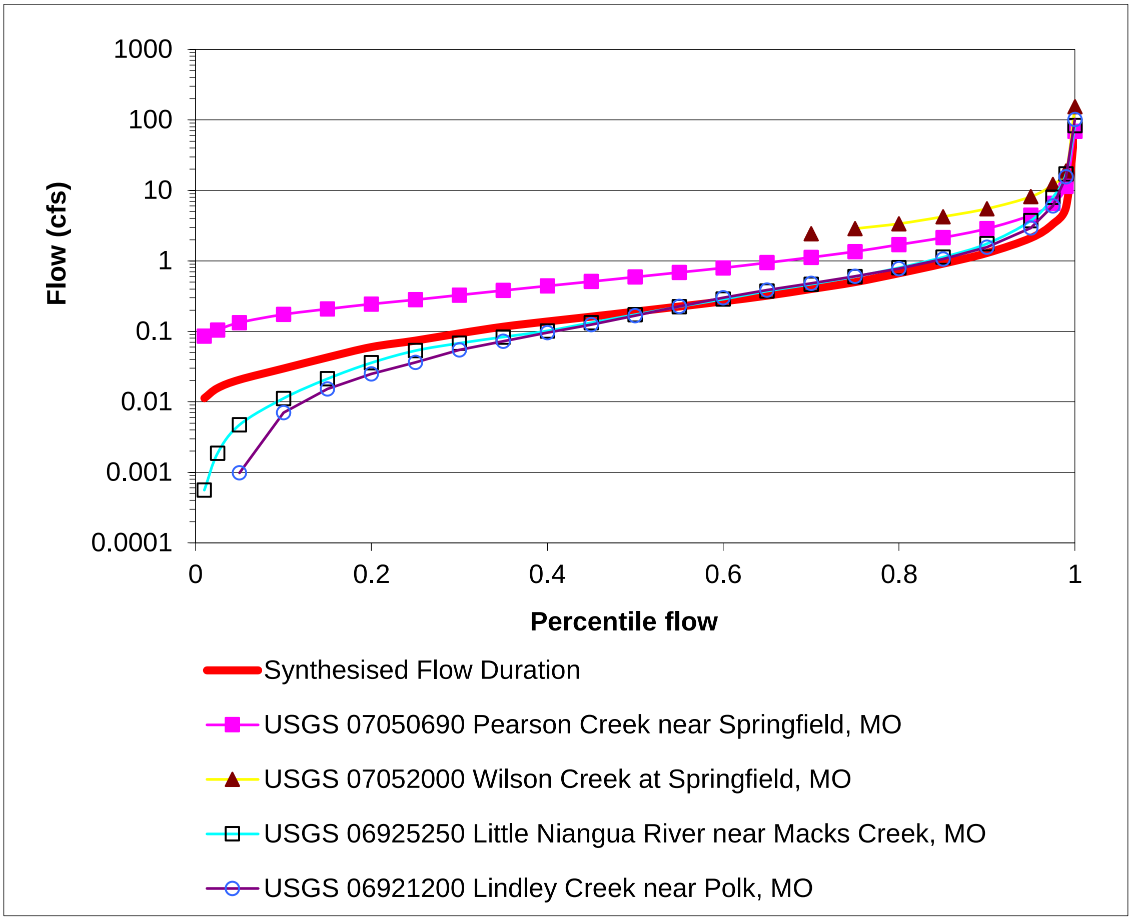

Figure B-1. EDU flow duration curve

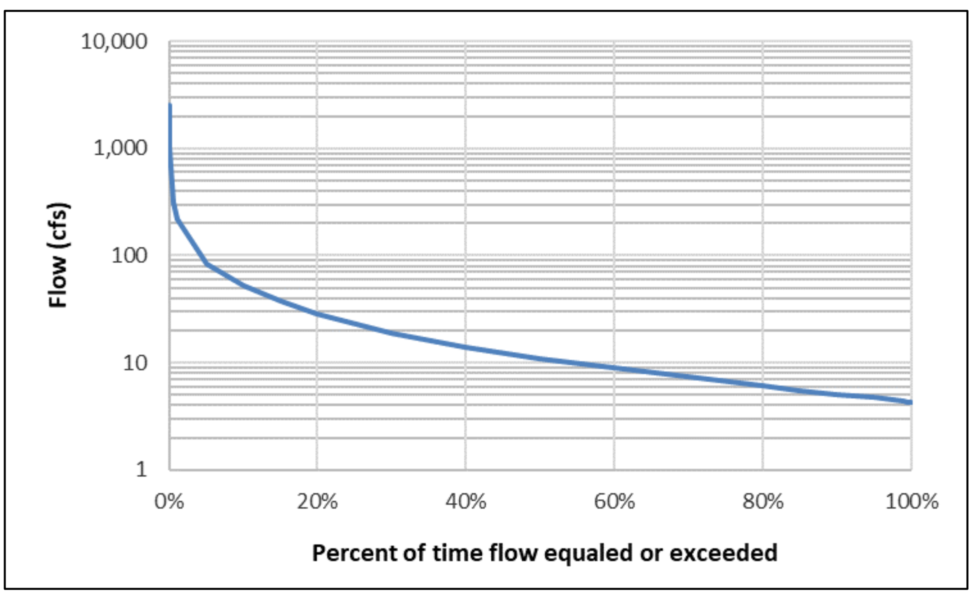

Figure B-2. Town Branch and Piper Creek flow duration curve

Table B-2. USGS total suspended solids data used to develop TMDL target (sorted by date)

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/18/1974	62.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/21/1974	44.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	12/19/1974	110.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/20/1975	30.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/13/1975	38.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/13/1975	62.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	4/17/1975	40.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/13/1975	54.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/4/1975	69.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/23/1975	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	8/29/1975	63.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/24/1975	46.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/28/1975	28.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/13/1975	122.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	12/18/1975	208.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/14/1976	35.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/4/1976	19.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/19/1976	9.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	4/8/1976	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/17/1976	374.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/17/1976	8.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/19/1976	16.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	8/19/1976	47.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/28/1976	54.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/18/1976	21.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	12/13/1976	61.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/12/1977	25.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/4/1977	65.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/4/1977	1.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	4/15/1977	64.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/13/1977	25.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/16/1977	55.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/7/1977	107.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	8/11/1977	192.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/15/1977	128.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/6/1977	93.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/4/1977	61.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	12/15/1977	64.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/23/1978	91.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/23/1978	60.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/16/1978	58.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	4/12/1978	160.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/25/1978	92.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/22/1978	133.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/13/1978	96.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	8/10/1978	36.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/19/1978	209.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	12/14/1978	76.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/7/1979	52.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/22/1979	151.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/14/1979	189.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/12/1979	206.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/12/1979	8.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/8/1979	357.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	12/12/1979	358.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/22/1980	77.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/27/1980	67.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	4/29/1980	77.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/12/1980	71.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/10/1980	68.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/23/1980	58.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/25/1980	2.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	12/16/1980	24.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/20/1981	22.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/24/1981	44.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/26/1981	114.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	4/22/1981	50.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/28/1981	495.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/24/1981	1070.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/28/1981	18.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	8/18/1981	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/12/1981	4.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/12/1982	28.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/25/1982	46.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/18/1982	71.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/20/1982	0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/15/1982	45.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/16/1982	19.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/24/1983	16.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/31/1983	63.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/25/1983	25.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/7/1983	313.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/29/1983	39.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/12/1984	41.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/16/1984	42.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/18/1984	48.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/27/1984	28.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/16/1984	26.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/18/1985	16.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/15/1985	29.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/10/1985	6.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/19/1985	29.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/19/1985	68.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/15/1985	64.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/16/1986	29.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/4/1986	7.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/8/1986	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/18/1986	25.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/2/1986	2.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/19/1986	4.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/15/1987	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/12/1987	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/15/1987	7.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/9/1987	14.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/10/1987	6.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/6/1987	60.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/14/1988	23.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/3/1988	35.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/9/1988	24.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/15/1988	24.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/7/1988	7.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/1/1988	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/10/1989	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/17/1989	7.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/18/1989	221.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/15/1989	35.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/19/1990	4.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/20/1990	29.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/7/1990	27.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/9/1990	71.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/14/1990	4.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/9/1991	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/7/1991	7.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/6/1991	48.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/15/1991	7.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/6/1991	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/24/1993	63.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/18/1993	36.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/21/1993	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/30/1993	64.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/10/1993	14.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/15/1994	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/7/1997	6.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/19/1998	14.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/6/1999	10.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/27/1999	23.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/8/1999	10.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/3/2000	6.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/21/2000	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/2/2001	13.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/7/2001	18.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/9/2002	10.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/7/2002	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/8/2002	152.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/15/2002	105.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/3/2002	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/12/2002	19.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/13/2003	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/10/2003	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/27/2003	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/14/2003	14.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/3/2003	25.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/24/2003	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/13/2004	8.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/8/2004	38.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/25/2004	47.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/6/2004	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/20/2004	17.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/29/2004	10.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/26/2005	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/9/2005	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/2/2005	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/13/2005	14.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/1/2005	24.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/3/2005	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/3/2006	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/6/2006	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/4/2006	81.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/6/2006	11.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/5/2006	30.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/2/2006	5.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/23/2007	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	2/6/2007	21.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/13/2007	26.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	4/24/2007	16.0
USGS	1031/28.5	Osage R. bl. St. Thomas	FieldDupl	5/8/2007	10.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	6/5/2007	23.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/11/2007	12.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/10/2007	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/20/2007	14.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/10/2008	38.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/27/2008	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/12/2008	14.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/30/2008	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/3/2008	81.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/12/2009	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/9/2009	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/4/2009	17.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/27/2009	16.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/2/2009	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/28/2009	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/4/2010	17.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/22/2010	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/26/2010	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/13/2010	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/8/2010	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/18/2010	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/3/2011	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/22/2011	16.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/4/2011	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/11/2011	20.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/7/2011	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/25/2011	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/24/2012	19.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/5/2012	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/2/2012	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/17/2012	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/6/2012	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/3/2012	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/31/2013	119.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/6/2013	37.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/22/2013	16.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/24/2013	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/18/2013	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	11/13/2013	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/14/2014	70.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/24/2014	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/14/2014	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/15/2014	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/3/2014	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/6/2014	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/5/2015	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/9/2015	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/5/2015	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/20/2015	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/14/2015	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/20/2015	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/11/2016	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/8/2016	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/23/2016	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/27/2016	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/12/2016	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/4/2016	50.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	1/18/2017	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/7/2017	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/24/2017	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/18/2017	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/13/2017	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/11/2017	7.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1031/28.5	Osage R. bl. St. Thomas	FieldDupl	1/16/2018	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	3/26/2018	18.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	5/22/2018	15.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	7/11/2018	7.5
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	9/11/2018	32.0
USGS	1031/28.5	Osage R. bl. St. Thomas	Grab	10/2/2018	7.5
USGS	1076/1.3	L. Tavern Cr. nr mouth	Grab	5/19/1994	4.0
USGS	1076/1.3	L. Tavern Cr. nr mouth	Grab	8/31/1994	5.0
USGS	1076/1.3	L. Tavern Cr. nr mouth	Grab	5/30/1995	18.0
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	1/14/1994	4.0
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	6/9/1994	8.0
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	1/25/1995	2.0
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	6/23/1995	4.0
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	1/30/1996	3.0
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	6/14/1996	1.0
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	1/21/1997	0.5
USGS	1103/3.4	Big Buffalo Cr. 2 mi. SW of Boylers Mill	Grab	6/13/1997	11.0
USGS	1139/0.6	Coakley Hollow	Grab	11/9/1993	0.5
USGS	1139/0.6	Coakley Hollow	Grab	4/6/1994	14.0
USGS	1139/0.6	Coakley Hollow	Grab	6/3/1994	6.0
USGS	1139/0.6	Coakley Hollow	Grab	8/25/1994	0.5
USGS	1139/0.6	Coakley Hollow	Grab	11/15/1994	8.0
USGS	1139/0.6	Coakley Hollow	Grab	4/24/1995	6.0
USGS	1139/0.6	Coakley Hollow	Grab	6/26/1995	2.0
USGS	1139/0.6	Coakley Hollow	Grab	8/30/1995	6.0
USGS	1139/0.6	Coakley Hollow	Grab	12/5/1995	0.5
USGS	1139/0.6	Coakley Hollow	Grab	4/24/1996	1.0
USGS	1139/0.6	Coakley Hollow	Grab	6/12/1996	2.0
USGS	1139/0.6	Coakley Hollow	Grab	8/21/1996	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/6/1982	2.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	12/16/1982	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	2/8/1983	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/15/1983	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	4/5/1983	38.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/3/1983	24.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/6/1983	12.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/5/1983	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	8/9/1983	14.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/22/1983	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/18/1983	0.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/10/1983	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	12/6/1983	7.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/3/1984	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	2/6/1984	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/5/1984	184.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	4/2/1984	6.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/8/1984	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/5/1984	6.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/10/1984	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	8/6/1984	2.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/11/1984	7.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/2/1984	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/5/1984	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	12/4/1984	6.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/11/1985	2.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	2/19/1985	14.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/18/1985	13.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	4/15/1985	7.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/21/1985	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/11/1985	107.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/9/1985	2.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	8/5/1985	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/9/1985	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/8/1985	6.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/12/1985	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	12/3/1985	10.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/7/1986	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	2/10/1986	6.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/18/1986	4.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	4/8/1986	14.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/13/1986	29.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/5/1986	153.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/7/1986	6.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	8/4/1986	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/16/1986	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/14/1986	10.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/5/1986	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	12/2/1986	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/5/1987	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	2/2/1987	4.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/2/1987	31.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	4/7/1987	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/19/1987	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/9/1987	4.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/7/1987	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	8/4/1987	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/1/1987	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/5/1987	3.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/3/1987	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	12/8/1987	9.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	2/2/1988	4.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/1/1988	14.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	4/5/1988	30.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/10/1988	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/10/1988	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/12/1988	9.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	8/2/1988	4.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/6/1988	32.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/17/1992	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/11/1993	18.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/5/1993	27.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/14/1993	396.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/26/1995	4.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/30/1995	22.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/31/1996	0.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/11/1996	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/22/1997	6.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/26/1997	8.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/20/1998	10.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/8/1998	4.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/19/1999	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/9/1999	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/15/1999	1.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/16/2000	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/20/2000	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/24/2001	8.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/1/2001	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/22/2002	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/18/2002	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/21/2002	18.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/29/2002	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/9/2002	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/13/2002	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/14/2003	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/11/2003	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/28/2003	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/17/2003	12.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/8/2003	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/25/2003	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/22/2004	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/11/2004	56.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/24/2004	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/7/2004	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/21/2004	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/17/2004	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/18/2005	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/21/2005	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/23/2005	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/25/2005	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/19/2005	12.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/29/2005	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/17/2006	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/20/2006	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/22/2006	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/24/2006	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/18/2006	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/2/2006	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/24/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	2/27/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/5/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	4/17/2007	15.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/9/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	6/25/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/23/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/17/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	11/5/2007	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/22/2008	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/17/2008	12.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/27/2008	5.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/21/2008	5.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/15/2008	112.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/26/2009	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/16/2009	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/20/2009	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/6/2009	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/1/2009	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/7/2009	15.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/21/2010	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/10/2010	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/5/2010	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/8/2010	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/1/2010	45.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/12/2010	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/12/2011	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/29/2011	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/11/2011	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/27/2011	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/7/2011	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/5/2011	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/17/2012	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/12/2012	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/9/2012	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/9/2012	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/6/2012	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/16/2012	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/16/2013	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/19/2013	38.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/23/2013	18.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/17/2013	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/3/2013	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/28/2013	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/13/2014	15.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/19/2014	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/7/2014	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/7/2014	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/2/2014	8.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/14/2014	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/20/2015	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/3/2015	15.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/20/2015	7.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/22/2015	15.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/1/2015	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/5/2015	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/5/2016	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/22/2016	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	FieldDupl	5/10/2016	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/13/2016	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/8/2016	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	FieldDupl	10/24/2016	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	1/4/2017	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/29/2017	15.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/8/2017	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/26/2017	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	9/19/2017	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	10/25/2017	28.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	3/5/2018	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	5/16/2018	15.0
USGS	1169/5.5	Niangua R.@Hwy 64	Grab	7/16/2018	7.5
USGS	1169/5.5	Niangua R.@Hwy 64	FieldDupl	9/12/2018	7.5
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	4/21/1993	20.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	5/20/1993	45.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	6/14/1993	86.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	7/8/1993	60.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	8/25/1993	39.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	9/14/1993	343.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	10/5/1993	10.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	11/15/1993	58.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	12/6/1993	13.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	1/4/1994	7.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	2/10/1994	4.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	3/7/1994	21.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	4/5/1994	6.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	5/17/1994	26.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	6/2/1994	13.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	6/14/1994	32.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	7/12/1994	19.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	8/11/1994	11.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	9/7/1994	31.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	10/4/1994	25.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	11/1/1994	8.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	12/6/1994	55.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	1/10/1995	10.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	2/6/1995	5.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	3/9/1995	18.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	4/3/1995	27.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	5/17/1995	33.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	6/20/1995	31.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	7/12/1995	32.0
USGS	1170/13.8	Niangua R. nr. Windyville	Grab	8/16/1995	42.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	4/21/1993	24.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	5/20/1993	9.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/14/1993	17.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	7/7/1993	37.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	8/25/1993	26.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	9/14/1993	90.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	10/5/1993	17.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	11/15/1993	28.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	12/6/1993	12.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	1/4/1994	0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	2/7/1994	1.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	2/22/1994	655.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	3/7/1994	16.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	3/22/1994	14.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	4/5/1994	2.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	4/14/1994	6.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	4/18/1994	5.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	4/28/1994	279.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	5/11/1994	4.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	5/16/1994	4.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	5/26/1994	1.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/2/1994	16.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/9/1994	5.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/14/1994	11.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/22/1994	3.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/29/1994	18.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	7/12/1994	3.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	7/25/1994	3.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	8/16/1994	2.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	9/1/1994	4.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	10/4/1994	10.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	10/31/1994	3.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	12/6/1994	10.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	1/9/1995	3.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	2/6/1995	2.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	3/8/1995	6.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	4/3/1995	23.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	5/17/1995	336.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/20/1995	20.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	7/12/1995	35.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	8/16/1995	24.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	11/21/1995	31.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	1/19/1996	20.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	4/3/1996	20.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	5/15/1996	10.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	6/27/1996	13.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	7/24/1996	19.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	8/19/1996	44.0
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	11/15/1996	0.1
USGS	1180/0.8	Dousinbury Cr. @Hwy JJ	Grab	2/27/1997	0.5
USGS	1370/8.1	Brush Creek ab Green Spring	Grab	5/25/1994	15.0
USGS	1370/8.1	Brush Creek ab Green Spring	Grab	9/21/1994	3.0
USGS	1370/8.1	Brush Creek ab Green Spring	Grab	5/23/1995	21.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/18/1983	22.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/10/1983	1.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/6/1983	2.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/3/1984	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/6/1984	1.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/5/1984	45.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/2/1984	17.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/8/1984	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/5/1984	21.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/10/1984	23.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/6/1984	12.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/11/1984	14.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/2/1984	4.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/5/1984	3.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/4/1984	14.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/10/1985	4.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/19/1985	8.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/18/1985	8.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/15/1985	20.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/21/1985	14.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/11/1985	113.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/5/1985	12.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/9/1985	1.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/8/1985	14.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/12/1985	2.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/6/1985	1.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/7/1986	1.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/10/1986	2.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/3/1988	6.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/1/1988	7.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/6/1988	6.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/3/1989	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/7/1989	3.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/9/1989	4.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/3/1989	7.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/9/1989	1.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/6/1989	13.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/17/1989	0.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/3/1989	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/5/1989	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/10/1989	0.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/6/1989	0.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/4/1989	3.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/8/1990	13.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/6/1990	11.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/5/1990	194.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/4/1990	0.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/10/1990	16.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/4/1990	6.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/26/1994	14.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/28/1994	8.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/10/1995	6.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/29/1995	14.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/16/1996	7.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/18/1996	37.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/3/1999	0.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/11/2000	2.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/24/2000	33.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/26/2000	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/29/2000	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/17/2001	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/23/2001	23.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/4/2001	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/26/2001	20.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/10/2001	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/8/2002	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/12/2002	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/13/2002	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/15/2002	16.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/20/2002	18.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/19/2002	4.9
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/22/2002	18.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/27/2002	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/11/2002	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/15/2002	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/4/2002	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/9/2002	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/22/2003	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/11/2003	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/18/2003	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/15/2003	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/14/2003	30.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/17/2003	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/8/2003	23.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/21/2003	13.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/8/2003	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/15/2003	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/5/2003	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/9/2003	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/20/2004	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/9/2004	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/11/2004	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/19/2004	17.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/12/2004	18.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/7/2004	16.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/19/2004	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/24/2004	14.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/13/2004	10.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/25/2004	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/16/2004	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/14/2004	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/20/2005	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/8/2005	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/29/2005	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/11/2005	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/24/2005	45.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/14/2005	23.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/27/2005	21.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/9/2005	12.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/19/2005	18.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/24/2005	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/29/2005	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/12/2005	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/17/2006	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/14/2006	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/20/2006	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/18/2006	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/23/2006	29.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/19/2006	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/27/2006	11.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/29/2006	20.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/18/2006	50.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/24/2006	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/15/2006	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/11/2006	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/22/2007	10.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/26/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/5/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/17/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/8/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/25/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/23/2007	12.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/7/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/17/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/16/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/6/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/17/2007	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/22/2008	5.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/13/2008	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/17/2008	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/22/2008	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/27/2008	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/3/2008	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/22/2008	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/4/2008	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/16/2008	5.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/28/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/3/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/17/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/6/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/19/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/2/2009	18.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/8/2009	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/17/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/1/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/6/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/2/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/7/2009	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/20/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/1/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/9/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/5/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/5/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/2/2010	24.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/8/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/3/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/2/2010	47.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/14/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/9/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/1/2010	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/13/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/8/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/31/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/20/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/10/2011	19.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/7/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/27/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/9/2011	7.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/7/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/5/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/1/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/6/2011	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/18/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/17/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/13/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/2/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/9/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/6/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/22/2012	19.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/5/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/22/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/13/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/4/2012	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/15/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/4/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/7/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/2/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/23/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/4/2013	17.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/17/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/19/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/3/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/30/2013	16.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/4/2013	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/3/2013	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/14/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/10/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/18/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/8/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/6/2014	10.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/5/2014	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/8/2014	29.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/5/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/3/2014	20.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/15/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/4/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/15/2014	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/14/2015	7.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/3/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/4/2015	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/13/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/19/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/8/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/14/2015	29.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/11/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/1/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/6/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/16/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/7/2015	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/25/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/1/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/21/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/12/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/11/2016	15.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/7/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/12/2016	33.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/22/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/7/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/24/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/9/2016	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	FieldDupl	12/5/2016	10.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	1/4/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/6/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	3/28/2017	21.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/17/2017	17.0
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/9/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/6/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/25/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/14/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/19/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	10/24/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	11/13/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	12/4/2017	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	2/14/2018	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	FieldDupl	3/5/2018	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	4/9/2018	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	5/15/2018	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	6/4/2018	7.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	7/17/2018	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	8/14/2018	7.5
USGS	1381/19.5	L. Sac R. @Walnut Grove	Grab	9/11/2018	7.5
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	11/10/1983	16.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	12/6/1983	5.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	1/3/1984	0.5
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	2/6/1984	1.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	3/5/1984	120.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	4/2/1984	42.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	5/8/1984	19.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	6/5/1984	33.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	7/10/1984	1.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	8/6/1984	12.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	9/11/1984	12.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	10/2/1984	5.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	11/5/1984	11.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	12/4/1984	8.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	1/10/1985	7.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	2/19/1985	15.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	3/18/1985	16.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	4/15/1985	18.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	5/21/1985	24.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	6/11/1985	74.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	7/10/1985	24.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	8/5/1985	11.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	9/9/1985	10.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	10/8/1985	15.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	11/12/1985	1.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	12/6/1985	1.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	1/7/1986	2.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	2/10/1986	1.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	3/20/1986	4.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	4/8/1986	480.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	5/13/1986	40.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	6/3/1986	106.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	7/9/1986	20.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	8/4/1986	24.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	9/16/1986	57.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	10/14/1986	5.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	11/5/1986	0.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	12/2/1986	6.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	1/5/1987	1.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	2/2/1987	5.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	3/2/1987	24.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	4/7/1987	6.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	5/19/1987	28.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	6/9/1987	32.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	5/24/1994	96.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	9/20/1994	34.0
USGS	1398/1.5	Sac R. nr. Dadeville	Grab	5/23/1995	107.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/10/1983	13.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	12/6/1983	6.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/3/1984	2.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	2/6/1984	1.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/5/1984	72.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/2/1984	11.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/8/1984	6.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/5/1984	16.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/10/1984	24.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/6/1984	8.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/11/1984	21.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/5/1984	4.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	12/4/1984	9.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/11/1985	4.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	2/19/1985	34.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/18/1985	11.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/15/1985	8.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/21/1985	13.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/11/1985	43.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/9/1985	3.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/5/1985	9.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/9/1985	20.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/8/1985	7.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/12/1985	1.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	12/3/1985	1.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/7/1986	1.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	2/10/1986	4.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/17/1992	0.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/12/1993	20.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/10/1993	8.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/5/1993	25.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/27/1993	19.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/28/1993	18.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/24/1993	4.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/27/1994	28.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/25/1994	45.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/28/1994	20.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/21/1994	11.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/23/1994	44.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/11/1995	4.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/29/1995	56.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/24/1995	26.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/7/1995	9.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/16/1996	0.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/19/1996	9.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/5/1996	0.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/4/1996	2.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/22/1997	8.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/24/1997	19.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/12/1997	28.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/4/1997	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/8/1998	12.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/13/1998	23.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/11/1999	0.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/12/1999	6.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/3/1999	7.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/22/2000	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/27/2000	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/23/2001	16.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/26/2001	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/9/2002	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/13/2002	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/20/2002	17.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/22/2002	12.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/9/2002	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/4/2002	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/23/2003	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/18/2003	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/14/2003	18.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/9/2003	19.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/8/2003	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/5/2003	10.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/20/2004	10.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/8/2004	11.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/12/2004	12.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/19/2004	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/13/2004	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/16/2004	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/20/2005	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/28/2005	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/23/2005	11.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/27/2005	15.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/19/2005	22.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/29/2005	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/17/2006	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/20/2006	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/22/2006	56.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/12/2006	13.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/18/2006	19.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	FieldDupl	11/15/2006	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/22/2007	28.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	2/27/2007	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/5/2007	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/17/2007	23.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/8/2007	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/25/2007	10.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/23/2007	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/17/2007	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	11/5/2007	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/22/2008	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/17/2008	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/27/2008	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/21/2008	5.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/15/2008	69.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/26/2009	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/17/2009	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/7/2009	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/19/2009	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/2/2009	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/7/2009	7.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/18/2009	19.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/1/2009	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/6/2009	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/20/2010	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/9/2010	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/5/2010	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/4/2010	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/2/2010	15.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/7/2010	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/2/2010	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/2/2010	746.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/13/2010	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/12/2011	16.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/30/2011	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/19/2011	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/10/2011	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/6/2011	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/26/2011	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/8/2011	18.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/7/2011	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/4/2011	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/18/2012	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/13/2012	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/3/2012	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/8/2012	17.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/5/2012	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/23/2012	17.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/5/2012	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/22/2012	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/15/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/5/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/1/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/22/2013	41.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/3/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/16/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/19/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/3/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/29/2013	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/13/2014	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/18/2014	7.5

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/8/2014	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/6/2014	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/4/2014	56.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/7/2014	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/6/2014	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/2/2014	20.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/15/2014	14.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/20/2015	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/4/2015	15.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/14/2015	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/19/2015	21.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/8/2015	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/14/2015	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/11/2015	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/1/2015	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/6/2015	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/5/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	FieldDupl	3/21/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/12/2016	64.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/11/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/6/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/12/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/23/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/7/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/24/2016	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	1/4/2017	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/28/2017	28.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/17/2017	62.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/9/2017	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	6/6/2017	18.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/25/2017	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	FieldDupl	8/14/2017	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/19/2017	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	10/24/2017	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	3/5/2018	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	4/10/2018	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	5/15/2018	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	FieldDupl	6/4/2018	15.0
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	7/16/2018	7.5
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	8/14/2018	17.0

Org.	Site Code	Site Name	Sample Type	Date	TSS w/ half detection limit (mg/L)
USGS	1440/11.8	Pomme de Terre R. nr. Polk	Grab	9/10/2018	25.0